

AD-A074 364

NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON  
NATIONAL DAM SAFETY PROGRAM. BOONTON RESERVOIR DAM (NJ-00255), --ETC(U)  
JUL 79 W A GUINAN

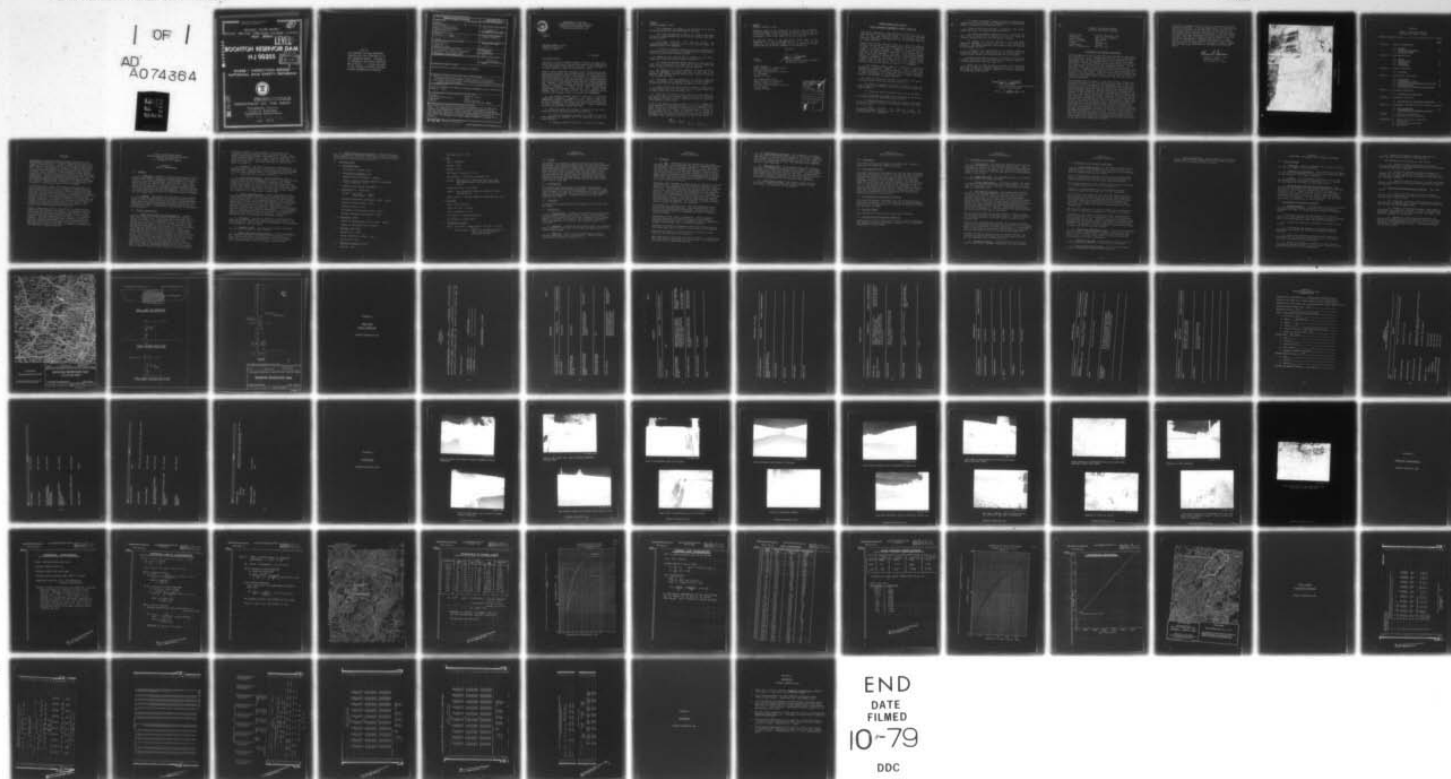
F/G 13/2

DACW61-79-C-0011

UNCLASSIFIED

NL

1 OF 1  
AD  
A074364



Approved for public release;  
distribution unlimited

*(Handwritten mark)*

PASSAIC RIVER BASIN  
STONY BROOK TRIBUTARY, MORRIS COUNTY  
NEW JERSEY

**LEVEL** *11*

**BOONTON RESERVOIR DAM**

**NJ 00255**



**PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM**



ORIGINAL CONTAINS COLOR PLATES: ALL DDC  
REPRODUCTIONS WILL BE IN BLACK AND WHITE.

**DEPARTMENT OF THE ARMY**

Philadelphia District  
Corps of Engineers  
Philadelphia, Pennsylvania

79 09 24 040  
July, 1979

DA 074364

DDC FILE COPY

NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED  
FROM THE BEST COPY FURNISHED US BY  
THE SPONSORING AGENCY. ALTHOUGH IT  
IS RECOGNIZED THAT CERTAIN PORTIONS  
ARE ILLEGIBLE, IT IS BEING RELEASED  
IN THE INTEREST OF MAKING AVAILABLE  
AS MUCH INFORMATION AS POSSIBLE.









IN REPLY REFER TO

NAPEN-D

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE - 2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, NJ 08621

16 SEP 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Boonton Reservoir Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Boonton Reservoir Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 41 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's reduced hazard classification and expectation that failure of the structure would probably result in no loss of life. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and supervise procedures for removal of trees and brush growing on the embankment and in the downstream toe area, and properly backfill.

(2) Design and supervise procedures for repair of the riprap.

NAPEN-D

Honorable Brendan T. Byrne

(3) Investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures.

(4) Design and supervise procedures for removal of the stumps on the crest and downstream face of the masonry spillway, and repair the holes created.

(5) Design procedures for repairing erosion and reestablishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment.

(6) Design and implement remedial measures for repairing the concrete crest of the spillway. Any remedial measures found necessary should be initiated within calendar year 1980.

c. Within one year from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and implement remedial measures to restore the low level outlet to operation if it exists; if it does not, design and install an adequate reservoir drain for emergency drawdown.

(2) Identify the size and condition of pipes and valves within the embankment, and repair such pipes as are found to be deficient. Any remedial measures found necessary should be initiated within calendar year 1980.

d. A program to check the condition of the dam once a month and monitor the seepage until remedial measures are effected should be initiated within 30 days from the date of approval of this report.

e. Within three months from the date of approval of this report the owner should clear trees and brush from the discharge channel and its banks and see that this area is kept clear.

f. Within one year from the date of approval of this report the owner should engage a professional engineer, qualified in the design and inspection of dams, to make a comprehensive technical inspection of the dam once every two years.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

79 09 24 040

NAPEN-D

Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

1 Incl  
As stated

*Joel T. Callahan*  
JOEL T. CALLAHAN

Lieutenant Colonel, Corps of Engineers  
Acting District Engineer

Copies furnished:

Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

John O'Dowd, Acting Chief  
Bureau of Flood Plain Management  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DDC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Availand/or special
<i>A</i>	



BOONTON RESERVOIR DAM (NJ00255)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 15 May 1979 by Anderson-Nichols & Co., Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Boonton Reservoir Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 41 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's reduced hazard classification and expectation that failure of the structure would probably result in no loss of life. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and supervise procedures for removal of trees and brush growing on the embankment and in the downstream toe area, and properly backfill.

(2) Design and supervise procedures for repair of the riprap.

(3) Investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures.

(4) Design and supervise procedures for removal of the stumps on the crest and downstream face of the masonry spillway, and repair the holes created.

(5) Design procedures for repairing erosion and reestablishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment.

(6) Design and implement remedial measures for repairing the concrete crest of the spillway. Any remedial measures found necessary should be initiated within calendar year 1980.

c. Within one year from the date of approval of this report, engineering studies and analyses should be performed to:

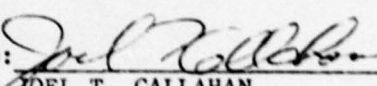
(1) Design and implement remedial measures to restore the low level outlet to operation if it exists; if it does not, design and install an adequate reservoir drain for emergency drawdown.

(2) Identify the size and condition of pipes and valves within the embankment, and repair such pipes as are found to be deficient. Any remedial measures found necessary should be initiated within calendar year 1980.

d. A program to check the condition of the dam once a month and monitor the seepage until remedial measures are effected should be initiated within 30 days from the date of approval of this report.

e. Within three months from the date of approval of this report the owner should clear trees and brush from the discharge channel and its banks and see that this area is kept clear.

f. Within one year from the date of approval of this report the owner should engage a professional engineer, qualified in the design and inspection of dams, to make a comprehensive technical inspection of the dam once every two years.

APPROVED: 

JOEL T. CALLAHAN

Lieutenant Colonel, Corps of Engineers  
Acting District Engineer

DATE: 13 September 1979

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Boonton Reservoir Dam
ID Number:	Fed. ID No. NJ00255
State Located:	New Jersey
County Located:	Morris
Stream:	Stony Brook
River Basin	Passaic
Date of Inspection:	May 15, 1979

ASSESSMENT OF GENERAL CONDITIONS

Boonton Reservoir Dam is about 80 years old and in poor overall condition. It is intermediate in size and is classified as Significant Hazard. Trees and brush are growing on the embankment and the downstream slope. The riprap is in poor condition. Extensive seepage was noted along the toe of the dam between the spillway and the northwest abutment. There are tree stumps on the crest and downstream face of the spillway. Trespassing and erosion are evident along the crest of the dam. Spalling and erosion of the visible portion of the core wall was noted. Trees and brush are overhanging and growing in the downstream channel. The spillway can pass less than 20% of the PMF without overtopping the dam and is considered inadequate.

We recommend that the owner, in the near future, design and supervise procedures for the removal of the trees, their root systems, and brush growing on the embankment and in the downstream toe area, and backfilling; investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures; design and supervise procedures for removal of the stumps on the crest and downstream face of the spillway, and repair holes after removal; clear the downstream area of brush, trees, and debris, and keep it cleared; design and supervise procedures for repair of the riprap; design procedures for repairing erosion and re-establishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment; design and implement remedial measures for repairing the concrete crest of the spillway; and determine the size and condition of water supply and other pipes passing through the embankment and design a reservoir drain system for emergency drawdown if none is found. Further evaluation of the hydrology and hydraulics of the dam and reservoir and design of additional spillway discharge capacity should be accomplished in the future by a professional engineer qualified in the design and inspection of dams.



We further recommend that as a part of operating and maintenance procedures: starting immediately, the owner should check the condition of the dam once a month and monitor the seepage until remedial measures are effected; a surveillance program should be established in the near future for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure; in the future, a professional engineer qualified in the design and inspection of dams should be engaged to make a comprehensive technical inspection of the dam once every two years.

*Warren A. Guinan*

Warren A. Guinan, P.E.  
Project Manager  
New Jersey No. 16848



15 MAY 1979

OVERVIEW

BOONTON RESERVOIR DAM

## CONTENTS

### PHASE I INSPECTION REPORT NATIONAL DAM SAFETY REPORT

BOONTON RESERVOIR DAM N.J. NO. 22-25 and FED ID NO. NJ00255

	<u>Page</u>
SECTION 1 PROJECT INFORMATION	
1.1 <u>General</u>	1
1.2 <u>Project Description</u>	1
1.3 <u>Pertinent Data</u>	3
SECTION 2 ENGINEERING DATA	
2.1 <u>Design</u>	5
2.2 <u>Construction</u>	5
2.3 <u>Operation</u>	5
2.4 <u>Evaluation</u>	5
SECTION 3 VISUAL INSPECTION	
3.1 <u>Findings</u>	6
SECTION 4 OPERATIONAL PROCEDURES	
4.1 <u>Procedures</u>	8
4.2 <u>Maintenance of Dam</u>	8
4.3 <u>Maintenance of Operating Facilities</u>	8
4.4 <u>Warning System</u>	8
4.5 <u>Evaluation of Operational Adequacy</u>	8
SECTION 5 HYDROLOGIC/HYDRAULIC	
5.1 <u>Evaluation of Features</u>	9
SECTION 6 STRUCTURAL STABILITY	
6.1 <u>Evaluation of Structural Stability</u>	10
SECTION 7 ASSESSMENT, RECOMMENDATIONS, REMEDIAL MEASURES	
7.1 <u>Dam Assessment</u>	12
7.2 <u>Recommendations/Remedial Measures</u>	12
FIGURES	
1. Regional Vicinity Map	
2. Essential Project Features	
APPENDICES	
1. Check List Visual Inspection	
2. Photographs	
3. Hydrologic Computations	
4. References	



## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY INSPECTION PROGRAM  
BOONTON RESERVOIR DAM  
U.S. #NJ00255 N.J. #22-25

SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Boonton Reservoir Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 4 April 1979 under contract No. FPM-39 dated 28 June 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 15 May 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Boonton Reservoir Dam and appurtenances based upon available data and visual inspection, and, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Boonton Reservoir Dam is a 15-foot high, 600-foot long earthfill dam, built about 1900. A cut stone core wall runs the full length of the dam. The downstream face is covered with riprap up to one foot in diameter and has a 1.5H:1V slope. Riprap has been placed at the toe of the embankment from the easterly abutment to the spillway to act as a toe drain. The slope of the upstream face is unknown. There is a stone masonry gate building located on the crest approximately 80 feet west of the east abutment. A pump house is located at the toe of the dam immediately below the gatehouse. The spillway is a free overflow, 90 feet long and constructed of dry stone masonry, capped with 8-inch thick concrete slabs. The concrete slabs are 5 feet wide. Immediately upstream is a 4.5-foot wide concrete apron. The crest width of the dam embankment varies from 9 to 12 feet. The easterly embankment abutment is at the westerly edge of Boonton Avenue (County Route 511) which parallels



the entire length of the reservoir. The slope rises gradually from the easterly side of Boonton Avenue. The westerly embankment abutment intersects with a steep natural slope (approximately 2H:1V). Approximately 4000 feet upstream of the dam a low causeway, with a 4-foot pipe arch, spans the reservoir. Essential features of the dam are given in Figure 2.

b. Location. The dam is located in Morris County, New Jersey on a tributary to Stony Brook, a tributary to the Rockaway River, approximately 1 mile northeast of Taylortown. It is at north latitude  $40^{\circ} 57.2'$  and west longitude  $74^{\circ} 23.0'$ . A location map is given in Figure 1.

c. Size Classification. Boonton Reservoir Dam is classified as being "intermediate" in size in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams, on the basis of storage (which governs rather than height) at the dam crest of 1265 acre-feet, which is less than 50,000 acre-feet, but more than 1,000 acre-feet. Its height of 14.9 feet, which is less than 40 feet, would have classified it otherwise as a small dam.

d. Hazard Classification. Visual inspection of the downstream area shows that failure of Boonton Reservoir Dam could possibly lead to the overtopping and failure of Deer Pond Dam downstream, and subsequent damage to the clubhouse downstream of Deer Pond Dam and approximately 8 houses, which are at least 10 feet above the discharge channel, in the Rockaway Valley section of Boonton. Substantial valley storage to reduce and attenuate the flood peak exists between Deer Pond Dam and the potential damage area. It is estimated that the affected structures could sustain only appreciable damage and that loss of life is unlikely. Thus Boonton Reservoir Dam is classified as Significant Hazard.

e. Ownership. The dam is owned by the Boonton Water Department, Town of Boonton, Morris County, New Jersey. Mr. Frank Costabile, Sewer and Water Superintendent, was contacted for information (201-334-3450).

f. Purpose of Dam. The lake was originally designed and is currently used for water supply.

g. Design and Construction History. Little information was disclosed regarding the design and construction of the dam. The original plans were prepared around 1900 and construction followed soon thereafter. No major modifications have been made since the original construction.



h. Normal Operational Procedures. Boonton Reservoir Dam is operated as the water supply for the Town of Boonton. Three quarters of a million to one million gallons per day are currently drawn from the reservoir.

1.3 Pertinent Data

a. Drainage Areas

Watershed 2.0 square miles

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Ungated (total) spillway capacity at maximum pool elevation - 613

Maximum water supply withdrawal - 1.5

c. Elevation (ft. above MSL)

Top Dam      Low Point   -   639.4  
                 High Point   -   640.7

Maximum pool-design surcharge ( $\frac{1}{2}$  PMF) - 640.8

Normal recreation pool - 637.5

Spillway crest - 637.5

Streambed at centerline of dam - 624.5

Maximum tailwater (estimated) - 627.2

d. Reservoir (feet)

Length of maximum pool (top of dam) - 8640'  $\frac{+}{-}$

Length of recreation pool - 8440'  $\frac{+}{-}$

e. Storage (acre-feet)

Normal pool - 1066

Design surcharge ( $\frac{1}{2}$  PMF) - 1435

Top of dam - 1270

f. Reservoir Surface (acres)

Top dam - 133

Spillway crest - 88.8

g. Dam

Type - Earthfill

Length - 600'

Height - 14.9'

Top Width - Varies 9' to 12'

Side Slopes - 1.5H:1V d/s, unknown u/s

Zoning - Earthfill d/s face with cut stone core  
and "puddle bank" upstream (from design  
plans)

Impervious Core - Cut stone

Cutoff - Cut stone core keyed into bedrock (from  
design plans)

Grout curtain - Partial added in 1960s (see Sec. 2.2)

h. Spillway

Type - Free overflow

Length of weir - 90 feet

Crest elevation - 637.5

U/S Channel - Boonton Reservoir

D/S Channel - Stony Brook

i. Regulating Outlets

Type - Low level - None visible (see Sec. 2.1 and  
5.1 a.)

Water Supply - Access in gatehouse on top of  
dam. Type of regulating  
mechanism unknown.

## SECTION 2 ENGINEERING DATA

### 2.1 Design

No hydraulic or hydrologic design engineering data were disclosed. The original design plans, on file at the Boonton Water Department show a 627-foot long earthfill dam with a cut-stone core wall and a "puddle bank" upstream. The plans also show an 18-inch, 24-foot long low level outlet pipe with an intake just upstream of the southeasterly end of the spillway and an outlet near the bottom of the southeasterly end of the spillway face. The design top of dam elevation is 640.5 feet MSL and the design spillway elevation is 637.5 feet MSL.

### 2.2 Construction

No recorded data concerning the original construction of Boonton Reservoir Dam were disclosed. The current water superintendent for the Town of Boonton stated that a partial grout curtain was added in the mid 1960s to reduce seepage through the embankment. Riprap along the toe was also added at that time.

### 2.3 Operation

No engineering data pertaining to operation of the dam were disclosed.

### 2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files, contact with community officials and contact with the owner revealed only a limited amount of recorded information. All disclosed information, with the exception of a copy of the original plans, was retrieved.

b. Adequacy. Because of the limited amount of recorded data available, evaluation of this dam was based primarily on visual observations.

c. Validity. Parts of the recorded data reviewed did not agree with visual observations. Specific discrepancies are discussed in Section 5.1 a.



### SECTION 3 VISUAL INSPECTION

#### 3.1 Findings

a. Dam. Trees and brush are growing on the crest, upstream face, and downstream face of the embankment between the spillway and the northwest abutment. Trees and brush are growing on the embankment from the southeast end of the spillway part way to the southeast abutment (ending about 2/3 of the distance from the left abutment to the spillway). Small brush is growing through the riprapped section of the downstream slope which extends from the southeast abutment part way to the spillway as shown on Figure 2. The riprap is in poor condition locally.

Extensive clear seepage was noted along the entire toe of the dam between the spillway and the northwest abutment. The seepage at the downstream toe near the spillway was estimated at 12 gpm. Some clear seepage was observed from the lower part of the contact between the embankment and the southeast abutment. This seepage is being channeled in a man-made ditch around a small wooden building near the toe of the dam. The area near the toe of the dam is generally soft and wet and covered with dense brush between the discharge channel and the southeast abutment. No evidence of bulging or other signs of slope instability were observed.

Tree stumps are located on the crest and downstream face of the stone masonry spillway. The concrete crest of the spillway is deteriorated and spalled. Several sections of the concrete crest have separated and brush is growing from the cracks.

Trespassing on the crest is extensive. Wheel tracks on the crest are bare of vegetation between the southeast abutment and the spillway. A footpath is bare of vegetation between the spillway and the northwest abutment.

Evidence of extensive trespassing and erosion were noted on the downstream slope adjacent to both sides of the spillway.

Extensive erosion of the upstream slope adjacent to both sides of the gatehouse has occurred.

Some spalling of the mortar as well as erosion of the top of the stone masonry core wall was noted where it is exposed on the crest of the embankment section.

b. Appurtenant Structures. The gatehouse was locked; thus the type of operating facilities it contains is unknown. The exterior of the gatehouse appears to be in fair condition. The concrete steps that descend from the top of the embankment to the downstream toe near the gatehouse were observed to be in good condition.

c. Reservoir Area. The watershed above the reservoir is gently to steeply sloping and heavily wooded. The slopes adjacent to the reservoir appear to be stable. No structures were observed on the shore of the reservoir. Sediment has accumulated behind the spillway to the elevation of the crest for a short distance upstream, but no other evidence of extensive sedimentation in the reservoir was observed.

d. Downstream Channel. The channel bottom appears to be soil. There is a moderately dense growth of trees and brush in and adjacent to the channel.

## SECTION 4 OPERATIONAL PROCEDURES

### 4.1 Procedures

No formal operating procedures were disclosed. Water is drawn off as needed for supply purposes.

### 4.2 Maintenance of Dam

No formal maintenance procedures for the dam were disclosed. From the condition of the dam it is apparent that a regular maintenance program has not been followed for the dam as a whole. An effort has been made to keep the crest and embankment slopes on the southeast side of the spillway clear of trees and brush and the seepage at the toe on that side of the dam has been channeled as described in Section 3.1 a. Maintenance of the dam to the northwest of the spillway has been neglected and Mr. Frank Costabile stated that this was because union workers refused to cross the spillway to accomplish such maintenance as has been performed southeast of the spillway.

### 4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were disclosed. From the condition of the appurtenant structures it is apparent that a regular maintenance program has not been followed.

### 4.4 Warning System

No description of any warning system was disclosed.

### 4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the remedial measures described in Section 7.2 b. should be implemented as prescribed.



## SECTION 5 HYDROLOGIC/HYDRAULIC

### 5.1 Evaluation of Features

a. Design Data. Two hydraulic features of the structure did not agree with the original design plans. The spillway is shown to be 100 feet in length on the plans and is actually 90 feet in length. The low level outlet pipe, shown in the plans to exit through the face of the spillway, could not be found.

b. Experience Data. No recorded hydraulic or hydrologic experience data were disclosed.

c. Visual Observations. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection, water less than 1-inch deep was passing over the spillway crest.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Boonton Reservoir Dam is based on a spillway design flood (SDF) equal to one-half the probable maximum flood (PMF) on the basis of the limited hazard observed downstream and in accordance with evaluation guidelines for dams classified as Significant Hazard and intermediate in size. The PMF has been determined by application of the SCS dimensionless unit hydrograph procedure to a 24-hour PMP storm of 22.5 inches. Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 3597 cfs.

The minimum elevation of the dam allows 1.9 feet of depth in the spillway before overtopping occurs. Under this head the spillway capacity is 613 cfs which is less than the required SDF.

Flood routing calculations indicate that Boonton Reservoir Dam will be overtopped for more than 4 1/2 hours to a maximum depth of 1.4 feet under half PMF conditions. It is estimated that the spillway can pass less than 20 percent of the PMF without overtopping, and thus is considered inadequate.

Because the dam is classified as Significant Hazard, the increase in downstream hazard due to overtopping failure was not assessed with a breach analysis.

e. Drawdown Capacity. Because the low level outlet could not be found, drawdown capability was not assessed.

## SECTION 6 STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability

a. Visual Observations. If the trees growing on the embankment and in the downstream toe area blow over and pull out their roots, or if a tree dies and its roots decay, serious seepage problems may result.

If the brush growing through the riprap on the downstream slope is allowed to grow into trees, problems similar to those associated with the existing trees may develop.

The riprap which is in poor condition may result in erosion or sloughing problems if it is not repaired.

Seepage at the downstream toe of the dam may result in long-term stability problems if it is not corrected.

The roots of tree stumps on the crest and downstream face of the masonry spillway may rot and leave open channels through spillway or the stumps may sprout new growth which will cause additional deterioration of the masonry and concrete. Continued deterioration of the concrete crest may result in erosion and loss of stone masonry under the concrete cap.

The lack of vegetation in vehicle tracks and a footpath on the crest of the dam is conducive to erosion of the crest.

Trespassing and erosion, particularly near the gatehouse and the spillway, if not controlled, could lead ultimately to breaching of the dam. Based on the visual inspection and limited data available it was not possible to determine the character of the dam foundation, the interior of the cross section. Therefore it is not possible to evaluate the factor of safety of the dam against sliding.

b. Design and Construction Data. Plans for the original dam show that it was designed to have a masonry wall core with a 10-foot "puddle bank" upstream of the masonry wall. An 18" x 24" low level outlet shown on the plans was not found during the visual inspection.

c. Operating Records. No operating records pertinent to the structural stability of the dam were disclosed.

d. Post-Construction Changes. No records pertinent to post-construction changes were disclosed.

e. Seismic Stability. Boonton Reservoir Dam is in Seismic Zone 1 and in accordance with the Phase I guidelines does not warrant seismic analysis.



SECTION 7  
ASSESSMENT, RECOMMENDATIONS, REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Boonton Reservoir Dam is about 80 years old and is in poor overall condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 a. and the operating and maintenance procedures in 7.2 b. should be implemented by the owner as prescribed below.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems that are listed in Sections 5 and 6. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain the services of a professional engineer, qualified in the design and inspection of dams, to accomplish the following in the near future:

(1) Design and supervise procedures for removal of trees, their root systems, and brush growing on the embankment and in the downstream toe area, and properly backfill.

(2) Design and supervise procedures for repair of the riprap.

(3) Investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures.

(4) Design and supervise procedures for removal of the stumps on the crest and downstream face of the masonry spillway, and repair the holes created.

(5) Design procedures for repairing erosion and re-establishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment.

(6) Design and implement remedial measures for repairing the concrete crest of the spillway.

and accomplish the following in the future:

(1) Conduct further hydrologic and hydraulic analyses and design and oversee modification of the spillway to provide additional capacity.

(2) Design and implement remedial measures to restore the low level outlet to operation if it exists; if it does not: design and install an adequate reservoir drain for emergency drawdown.

(3) Identify size and condition of pipes and valves within the embankment, and repair such pipes as are found to be deficient.

b. Operating and Maintenance Procedures. The owner should:

(1) Clear trees and brush from the discharge channel and its banks and see that this area is kept clear. This should be started soon.

(2) Check the condition of the dam once a month and monitor the seepage until remedial measures are effected. This should be started immediately.

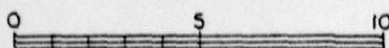
(3) Engage a professional engineer, qualified in the design and inspection of dams, to make a comprehensive technical inspection of the dam once every two years. This should be started in the future.

(4) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure. This should be done in the near future.





SCALE IN MILES



MAP BASED ON STATE OF NEW JERSEY  
OFFICIAL HIGHWAY MAP AND GUIDE.

Anderson-Nichols & Co., Inc.

BOSTON

MASSACHUSETTS

U.S. ARMY ENGINEER DIST. PHILADELPHIA  
CORPS OF ENGINEERS  
PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

## BOONTON RESERVOIR DAM LOCATION MAP

TRIBUTARY TO STONY BROOK

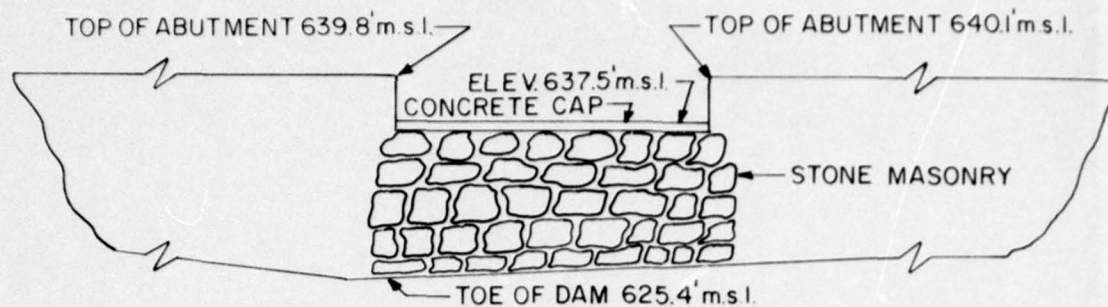
NEW JERSEY

SCALE: SEE BAR SCALE

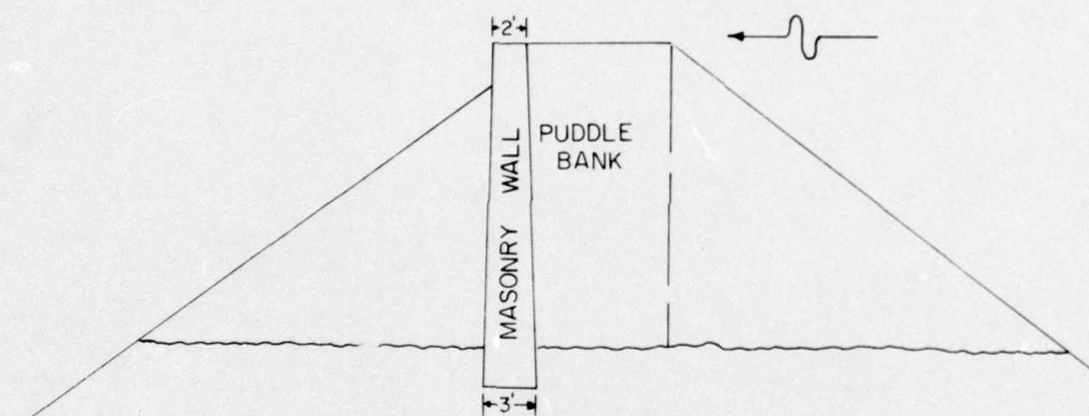
DATE:

Figure 1

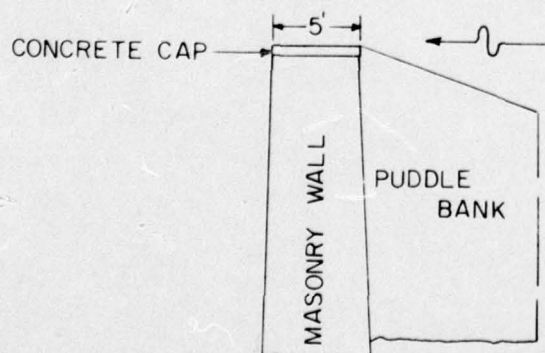




SPILLWAY ELEVATION

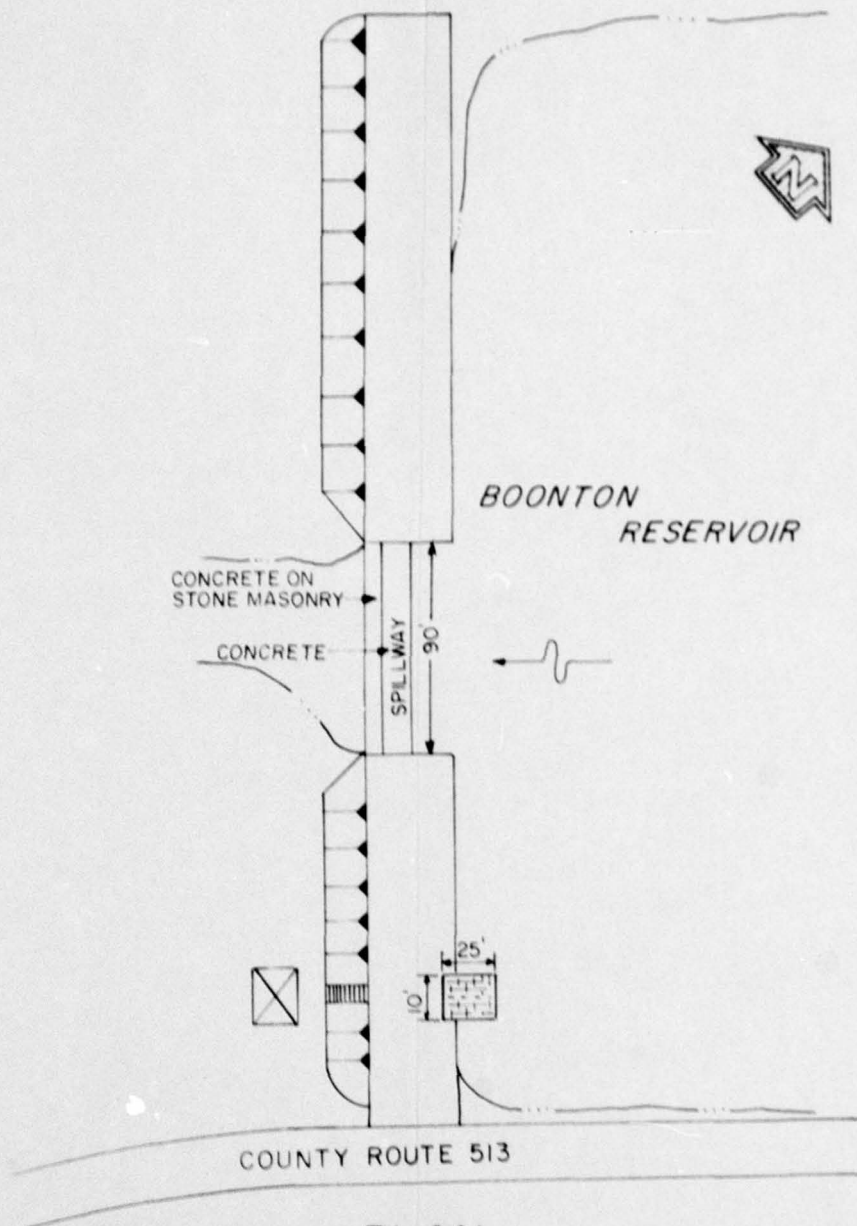


DAM CROSS SECTION



SPILLWAY CROSS SECTION

m.s.l.



PLAN

2

DATA FROM FIELD INSPECTION MAY 15, 1979

Anderson-Nichols & Co., Inc. BOSTON MASSACHUSETTS		U.S. ARMY ENGINEER DIST PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
BOONTON RESERVOIR DAM			
BOONTON RESERVOIR		NEW JERSEY	
		SCALE: NOT TO SCALE	
		DATE: JULY, 1979	

FIGURE 2

APPENDIX 1

CHECK LIST

VISUAL INSPECTION

BOONTON RESERVOIR DAM



Check List  
Visual Inspection  
Phase 1

Name Dam Boonton Reservoir Dam County Morris State New Jersey Coordinators N.J. D.E.P.  
 Date(s) Inspection 5/15/79 Weather Sunny, hot Temperature 75°  
 Pool Elevation at Time of Inspection 637.5 MSL Tailwater at Time of Inspection 624.7 MSL

Inspection Personnel:

<u>Warren Guinan</u>	<u>Ronald Hirschfeld</u>
<u>Stephen Gilman</u>	<u></u>
<u>David Deane</u>	<u></u>

Gilman and Hirschfeld Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None apparent.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None apparent.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some erosion of upstream slope on left side and right side of gatehouse.	Repair erosion.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good	
RIPRAP FAILURES	Riprap, which covers downstream slope from left abutment to a point about 30 feet west of gatehouse is quite uneven. Brush beginning to grow through riprap.	Clear brush growing through riprap.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Trespassing and erosion of downstream slope of embankment near training wall on right side downstream of spillway. Stone masonry core on left side of dam has numerous small cracks and spalling of small stones on surface.	Repair erosion and prevent trespassing. Riprap should be repaired.  Only the top surface of the core wall was visible.
ANY NOTICEABLE SEEPAGE	Major seepage occurring at downstream toe along practically the entire length of the dam.	Investigate seepage and design remedial measures.
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	



OUTLET WORKS - None Visible

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		
INTAKE STRUCTURE		
OUTLET PIPE		
OUTLET CHANNEL		
EMERGENCY GATE		

# UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete cap poured in two sections. Numerous cracks and evidence of movement between sections. Small brush growing in cracks. At least 2 small areas (2 sq. ft.) of concrete cap broken and spalled away.	Brush should be removed. Concrete cap should be repaired or replaced.
CONCRETE capped stone masonry		
APPROACH CHANNEL	Wide and unobstructed sediment fills channel to elevation of upstream edge of spillway crest.	
DISCHARGE CHANNEL	Soil bottom. Covered with brush and trees.	Clear trees and brush from channel and channel banks.
BRIDGE AND PIERS OVER SPILLWAY.	None	

# INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER	None observed.	



# DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Soil bottom. Brush and trees in and adjacent to channel.	Clear trees and brush from channel and channel banks.
SLOPES	Gentle slopes, heavily wooded.	
APPROXIMATE NO. OF HOMES AND POPULATION	Eight homes with an estimated population of 30 people in Rockaway Valley Section of Boonton approximately 1 mile downstream of Deer Pond Dam which is approximately 2 miles downstream of the subject dam.	

# RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle slopes. Heavily wooded, except that a highway is close to the left bank near the dam.	
SEDIMENTATION	Not visible beneath reservoir surface, except near spillway as noted above.	

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 2 square miles, wooded and hilly  
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 637.5' (1066 acre-ft.)  
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 639.4' (1265 acre-ft.)  
ELEVATION MAXIMUM DESIGN POOL: 640.7'  
ELEVATION TOP DAM: 639.4'  
CREST: Free overflow concrete-capped spillway  
a. Elevation 637.5'  
b. Type concrete weir  
c. Width 5'  
d. Length 90'  
e. Location Spillover approximate center of dam  
f. Number and Type of Gates none  
OUTLET WORKS: none visible  
a. Type \_\_\_\_\_  
b. Location \_\_\_\_\_  
c. Entrance Inverts \_\_\_\_\_  
d. Exit Inverts \_\_\_\_\_  
e. Emergency Draindown Facilities \_\_\_\_\_  
HYDROMETEOROLOGICAL GAGES: none  
a. Type \_\_\_\_\_  
b. Location \_\_\_\_\_  
c. Records \_\_\_\_\_  
MAXIMUM NON-DAMAGING DISCHARGE: 613 cfs



CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Original on file at Town of Boonton Water Department
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	None disclosed
TYPICAL SECTIONS OF DAM	Prepared for this report from sketches taken from original plans and visual observations.
HYDROLOGIC/HYDRAULIC DATA	No original data disclosed
OUTLETS - PLAN	None disclosed
- DETAILS	None disclosed
- CONSTRAINTS	None disclosed
- DISCHARGE RATINGS	None disclosed
RAINFALL/RESERVOIR RECORDS	None disclosed

ITEM	REMARKS
DESIGN REPORTS	None disclosed.
GEOLOGY REPORTS	None disclosed.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None disclosed.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None disclosed.
POST-CONSTRUCTION SURVEYS OF DAM	None disclosed.
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SERVICES	None.
MODIFICATIONS	Partial grout curtain and toe drain added in 1960's
HIGH POOL RECORDS	None disclosed.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None disclosed.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None disclosed.
MAINTENANCE OPERATION RECORDS	None disclosed.



ITEM	REMARKS
SPILLWAY PLAN	Prepared for this report from sketches taken from original plans and visual observations.
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Not visible. None.

APPENDIX 2

PHOTOGRAPHS

BOONTON RESERVOIR DAM



15 MAY 1979

VIEW OF CREST FROM RIGHT SPILLWAY ABUTMENT LOOKING  
SOUTHEAST



15 MAY 1979

VIEW OF CREST FROM LEFT SPILLWAY ABUTMENT  
LOOKING NORTHWEST





15 MAY 1979

VIEW OF DAM CREST FROM LEFT SPILLWAY ABUTMENT  
TOWARDS ROAD

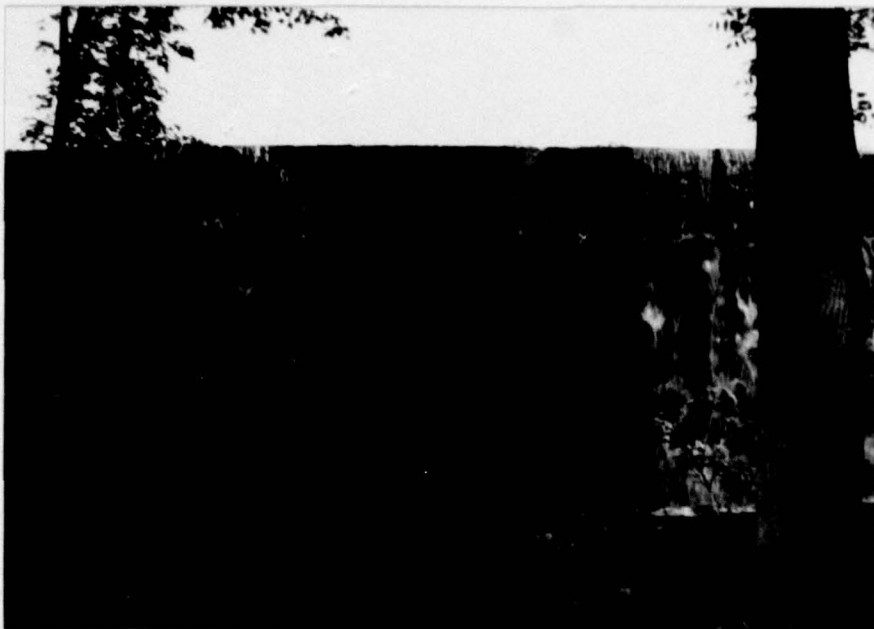


15 MAY 1979

VIEW SHOWING CREST OF DAM FROM RIGHT SIDE OF ROAD

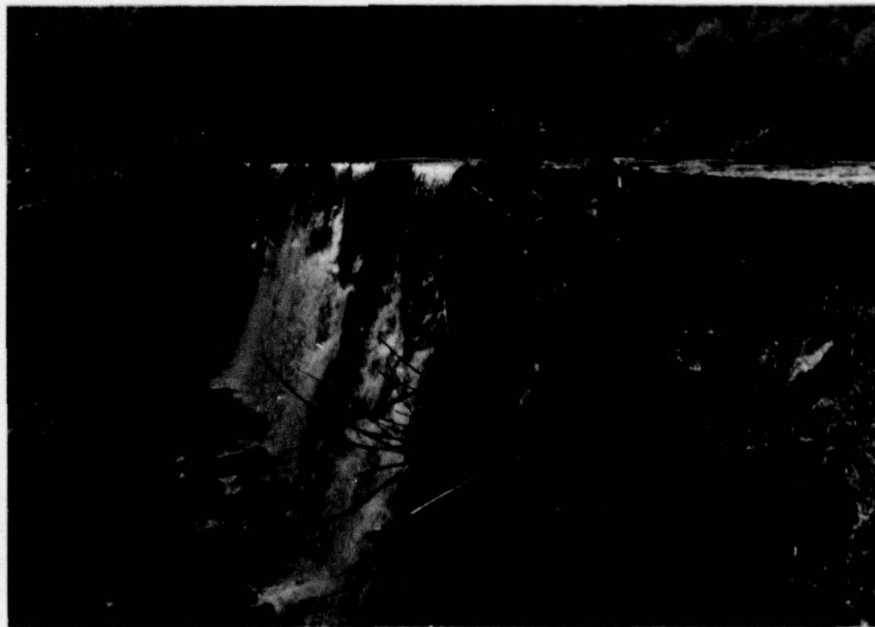
BOONTON RESERVOIR DAM

2-2



15 MAY 1979

VIEW OF DOWNSTREAM FACE OF SPILLWAY



15 MAY 1979

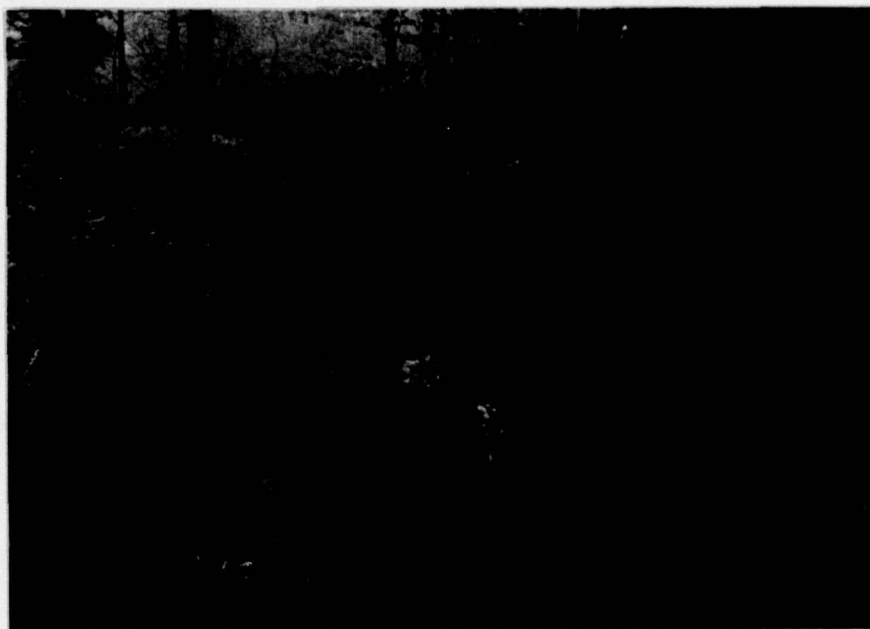
TREE STUMP IN DOWNSTREAM FACE OF SPILLWAY

BOONTON RESERVOIR DAM



15 MAY 1979

VIEW UPSTREAM FROM CENTER OF SPILLWAY



15 MAY 1979

VIEW OF DOWNSTREAM CHANNEL

BOONTON RESERVOIR DAM





15 MAY 1979

VIEW FROM SOUTHEAST SIDE OF RESERVOIR TOWARD DAM



15 MAY 1979

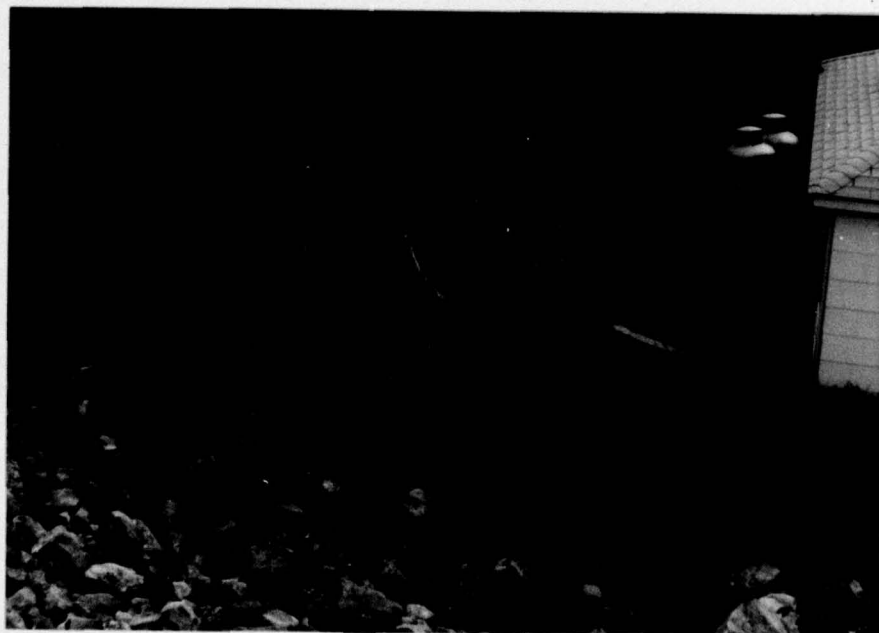
VIEW FROM NORTHWEST SIDE OF RESERVOIR TOWARD DAM

BOONTON RESERVOIR DAM



15 MAY 1979

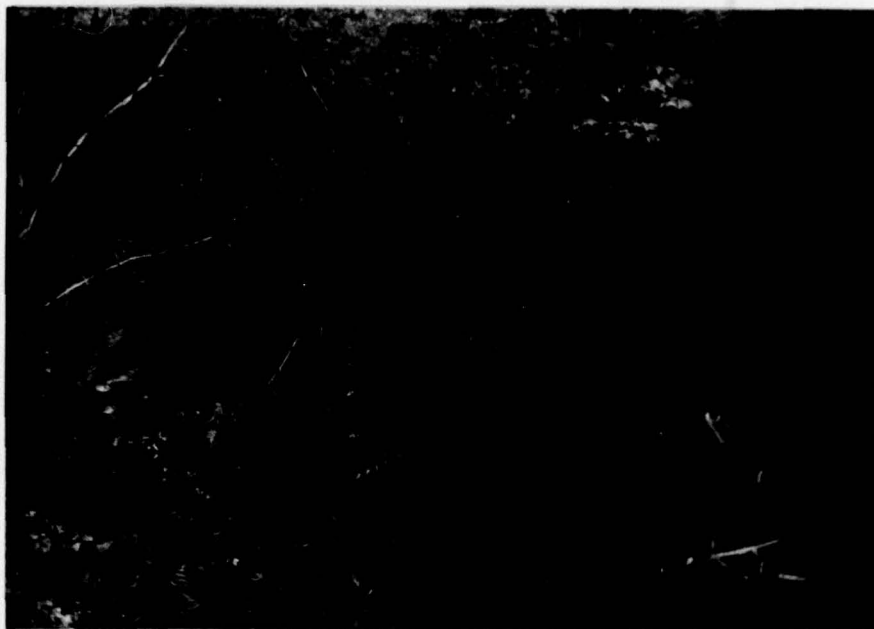
VIEW SHOWING DOWNSTREAM FACE OF DAM WITH GATE-  
HOUSE AND PUMP HOUSE



15 MAY 1979

WET AREA, SEEPAGE, AND COLLECTION DITCH  
AT D/S TOE OF DAM LEFT OF GATEHOUSE

BOONTON RESERVOIR DAM



15 MAY 1979

LARGE SEEPAGE AT DOWNSTREAM TOE OF DAM NEAR RIGHT  
ABUTMENT VIEWED FROM CREST



15 MAY 1979

SEEPAGE AT LEFT TOE OF DAM

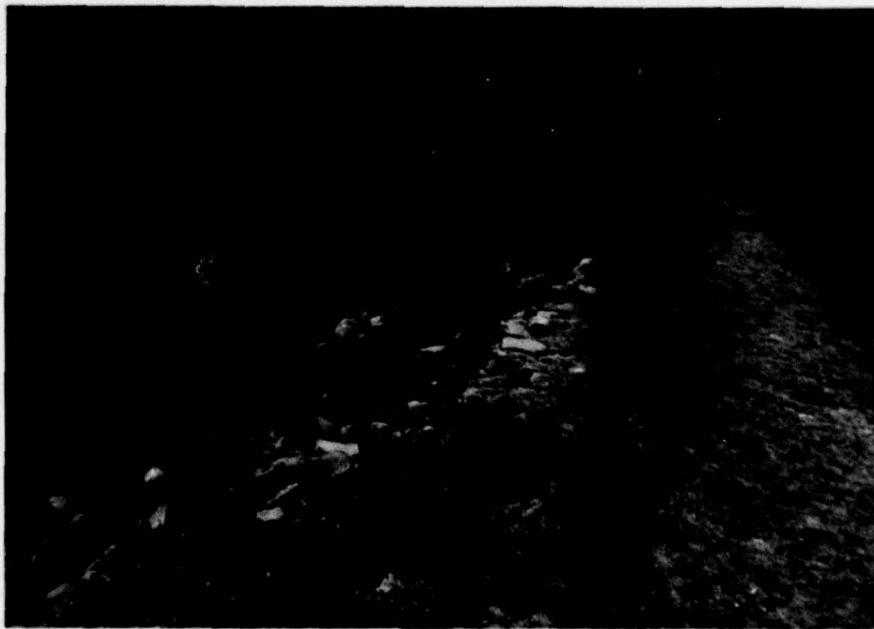
BOONTON RESERVOIR DAM





15 MAY 1979

CONTACT AT LEFT ABUTMENT



15 MAY 1979

VIEW SHOWING RIPRAP ON DOWNSTREAM FACE AND CORE  
WALL ALONG DOWNSTREAM EDGE OF CREST IMMEDIATELY  
WEST OF GATEHOUSE



15 MAY 1979

VIIW ALONG CREST OF DAM FROM RIGHT DAM  
ABUTMENT SHOWING FOOTPATH

APPENDIX 3

HYDROLOGIC COMPUTATIONS

BOONTON RESERVOIR DAM



Anderson-Nichols & Company, Inc.

Subject BOONTON RESERVOIR

Sheet No. 1 of 11  
Date \_\_\_\_\_  
Computed KATE  
Checked EDD

JOB NO. 3290-10

SQUARES  
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

## HYDROLOGIC COMPUTATIONS

NAME: BOONTON RESERVOIR DAM

LOCATION: MORRIS COUNTY, NJ

DRAINAGE AREA: 20 SQ. MILES

SURFACE AREA AT NORMAL POOL: 88.8 ACRES

EVALUATION CRITERIA: SIZE- INTERMEDIATE  
HAZARD- SIGNIFICANT

SPILLWAY DESIGN FLOOD: BASED ON SIZE AND HAZARD CLASSIFICATION, THE SPILLWAY DESIGN FLOOD WILL BE  $\frac{1}{2}$  PMF (PROBABLE MAXIMUM FLOOD). THE PMF IS EQUIVALENT TO 22.5 INCHES OF RAINFALL, AND HAS A PEAK INFLOW OF 10409 CFS. AN INFLOW HYDROGRAPH WILL BE DEVELOPED USING THE SCS TRIANGULAR UNIT HYDROGRAPH WITH CURVILINEAR TRANSFORMATION UTILIZING THE SPECIFIED K-VALUE OF 256.

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DOD

JOB NO. 3290-10

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DETERMINE TIME OF CONCENTRATION① TAKE OVERLAND FLOW FROM FARTHEST POINT  
TO UNPAVED ROAD

$$L = 650' \quad H = 100'$$

② BY KIRPICH NOMOGRAPH  $T_c = 2.4$  mins

③ BY IZZARDS FORMULA

$$T_c = \frac{L^{1.115}}{7700(H^{.38})} = \frac{650^{1.115}}{(7700 \times 100^{.38})} = .03 \text{ hrs} = 1.9 \text{ mins}$$

where  $L = \text{length (ft)}$   
 $H = \text{head (ft)}$ 

④ BY CALIFORNIA CULVERT EQUATION

P. 71 DESIGN OF SMALL DAMS

$$T_c = \left[ \frac{11.9L^3}{H} \right]^{.385} = \left[ \frac{(11.9)(650^3)}{100} \right]^{.385} = .040 \text{ hrs} = 2.4 \text{ mins}$$

where  $L = \text{length (mi.)}$   
 $H = \text{head (ft)}$ 

⑤ BY WESTON FORMULA

velocity derived from TEXAS HIGHWAY TABLE P. 70  
DESIGN OF SM. DAMS

$$T_c = \frac{L}{3600V} = \frac{650}{(3600 \times 3.5)} = 0.05 \text{ hrs} = 3 \text{ mins.}$$

where  $L = \text{length (ft)}$   
 $V = \text{velocity (cfs)}$ AVERAGE  $T_c$  REACH 1 = 2.4 mins

JOB NO. 3290-10SQUARES  
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

REACH 2 FROM UNNAMED ROAD TO BOONTON  
RESERVOIR.  $L = 4550'$   $H = 130'$

Ⓐ KIRPICH NOMOGRAPH  $T_c = 20.5$  mins

Ⓑ BY CALIFORNIA CULVERT EQUATION  
P. 71 DESIGN OF SMALL DAMS

$$T_c = \left[ \frac{(11.9)(L \text{ mi.}^3)^{.385}}{H \text{ ft}} \right] = \left[ \frac{(11.9)(.862)^3}{130} \right] = .34 \text{ hrs} = 20.4 \text{ mins}$$

Ⓒ BY WESTON FORMULA

VELOCITY DERIVED FROM TEXAS HIGHWAY TABLE, P. 70, DESIGN OF  
SMALL DAMS

$$T_c = \frac{L}{3600 V} = \frac{4550'}{(3600)(3.0)} = .42 \text{ hrs} = 25.2 \text{ mins}$$

$$\text{AVG } T_c \text{ REACH 2} = (20.5 + 20.4 + 25.2) \div 3 = 22.0 \text{ mins}$$

$$\text{TOTAL } T_c = 22.0 + 2.4 = 24.4 \text{ mins} = .41 \text{ hrs.}$$



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

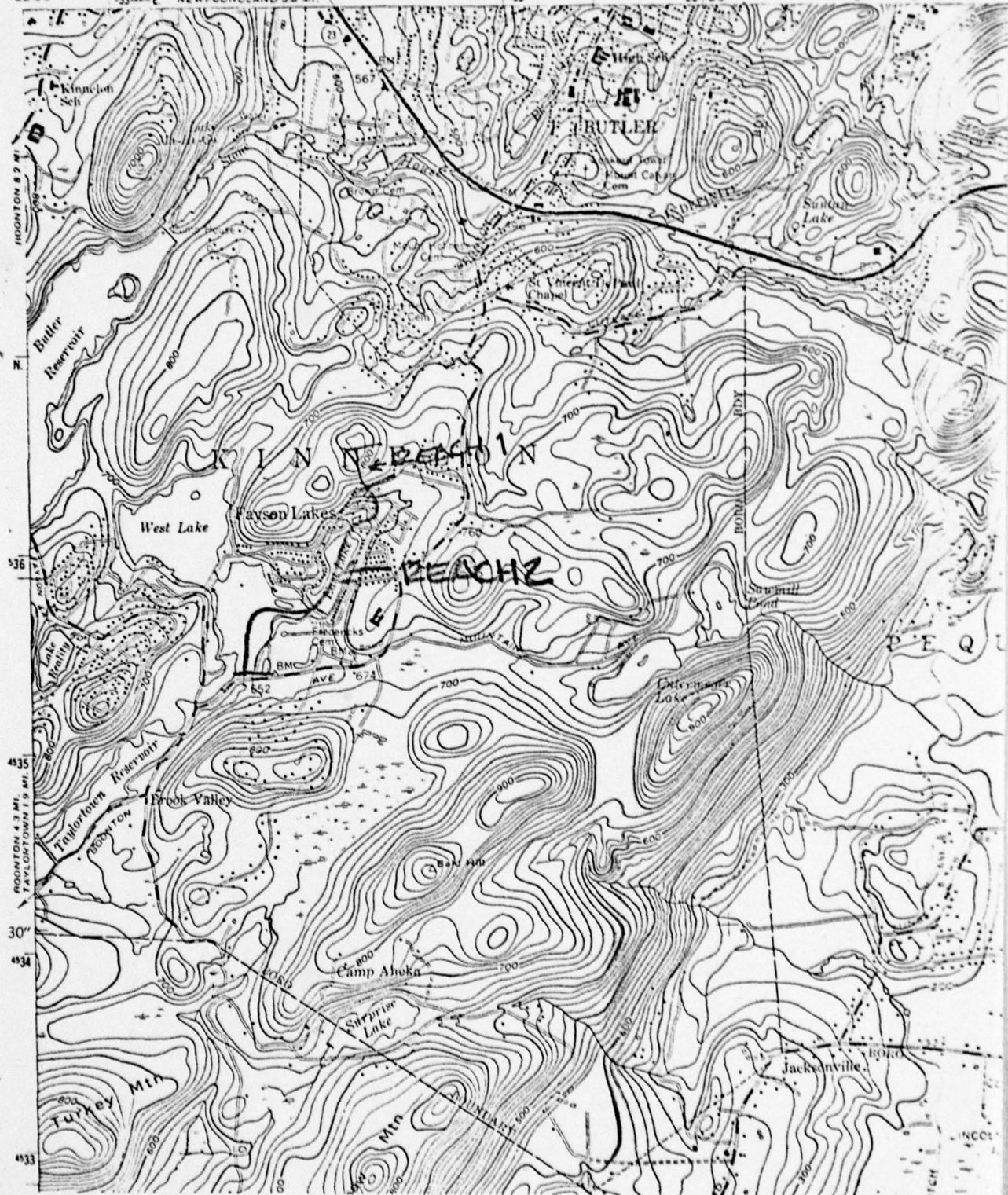
10011  
6/1/70  
100  
U:  
DEPAR  
COF

22°30" 1530000 E NEWFOUNDLAND 5.8 MI.

155

156 20'

157



JOB NO. 3290-10

SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
1/4 IN. SCALEDEVELOPMENT OF RATING CURVE

ELEVATION	SPILLWAY HEAD FT	Q CFS	DAM HEAD FT	DAM LENGTH FT	Q CFS	COMBINED Q CFS
637.5	0	0			0	0
639.4	1.9	613	0	510	0	613
639.6	2.1	712	.2	510	114	826
640	2.5	925	.6	510	593	1518
640.5	3.0	1216	1.1	510	1471	2687
641	3.5	1532	1.6	535	2707	4239
641.5	4.0	1872	2.1	560	4260	6132
642	4.5	2234	2.6	580	6079	8313
644	6.5	3878	4.6	585	14429	18307
646	8.5	5799	6.6	590	25010	30809
648	10.5	7962	8.6	595	37515	45477
650	12.5	10341	10.6	600	51767	62108

$$Q = CLH^{3/2} \quad \text{where } C = \text{COEFFICIENT} = 2.6 \text{ FOR SPILLWAY} \\ = 2.5 \text{ FOR DAM}$$

$L = \text{LENGTH (FT)} = 90 \text{ FOR SPILLWAY}$   
VARIES FOR DAM

$H = \text{HEAD (FT)}$

"HANDBOOK OF HYDRAULICS" KING & BRATER TABLE 5.46  
USED FOR DETERMINING SPILLWAY COEFFICIENT

FDD ESTIMATED DAM COEFFICIENT

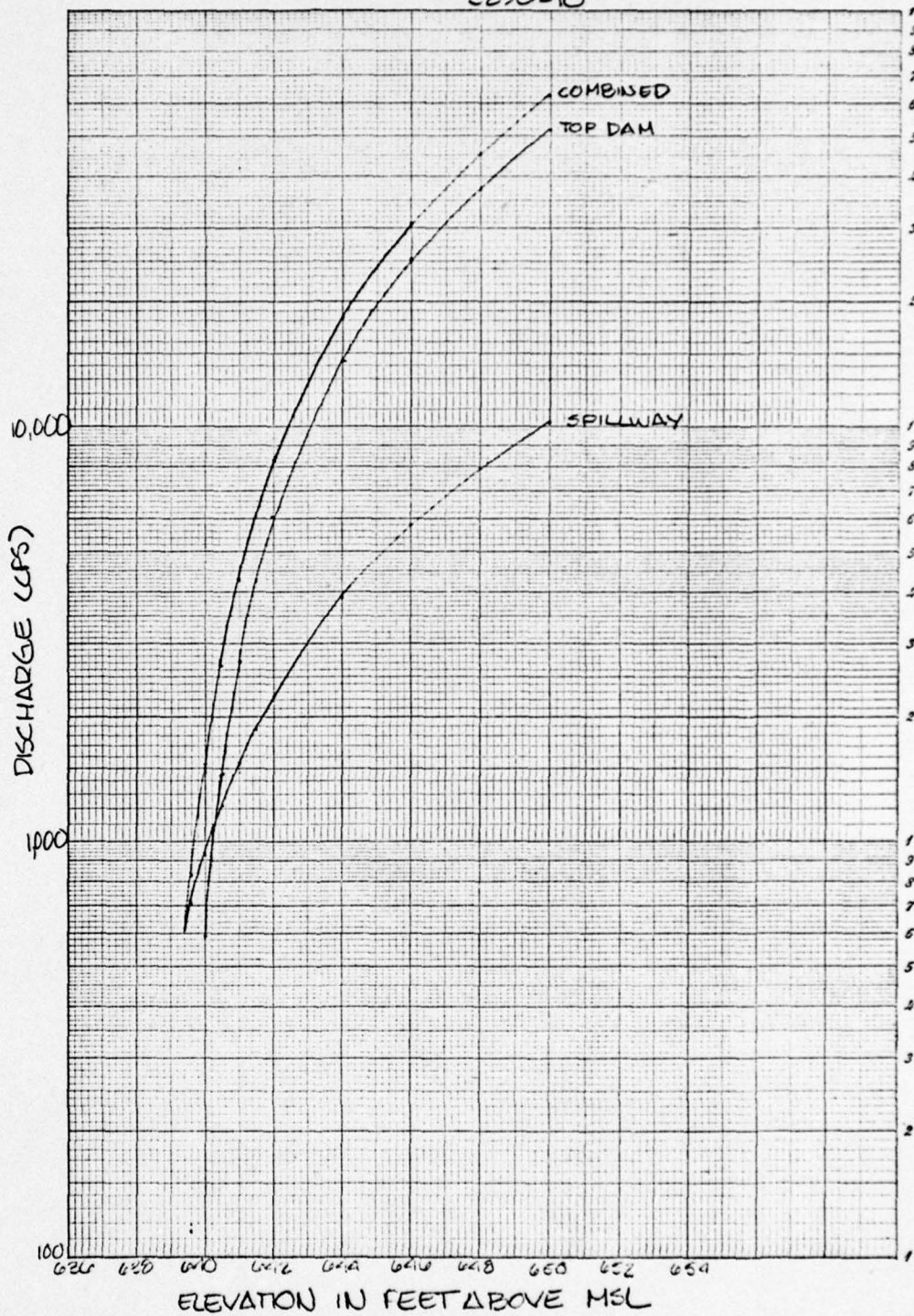
THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC



21.3 TO  
20  
666.1

# BOONTON RESERVOIR DAM COMBINED DATING CURVE 3290-10

NO. 3115-R. 20 DIVISIONS PER INCH (120 DIVISIONS) BY 3 1/2-INCH CYCLES RATIO RULING.  
**codex**  
 GRAPH PAPER  
 IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062  
 PRINTED IN U.S.A.





JOB NO. 3290-10SQUARES  
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DEVELOP UNIT HYDROGRAPH

$$\text{TIME OF CONCENTRATION} = 24.4 \text{ mins} = .41 \text{ hrs}$$

$$\text{LAG} = .6 T_c = .25 \text{ hrs}$$

DETERMINATION OF TIME OF PEAK

$$T_p = \frac{D}{2} + .6 T_c \quad \text{where } D = 5 \text{ mins} = 0.08 \text{ hours}$$

$$T_p = \frac{.08}{2} + .25 = .29$$

UNIT HYDROGRAPH

$$\text{TAKE } T_p = .33$$

TAKE  $Q_p$  FROM SCS FORMULA

$$\text{TAKE } A = \text{AREA IN SQ MI.} = 2.0$$

$$Q_p = \frac{2.56 A}{T_p} = \frac{(2.56)(2)}{.33} = 1552 \text{ CFS}$$

A CURVILINEAR HYDROGRAPH MAY BE CONSTRUCTED  
FOR THE VALUES OF  $Q_p$  AND  $T_p$  BY USING  
SCS RATIOS (P.74 DESIGN OF SMALL DAMS)

Subject BOONTON RESERVOIR

Sheet No. 8 of 11  
Date 6/24/9  
Computed PLB  
Checked PLB

## UNIT HYDROGRAPH

SQUARES 0  
1/4 IN. SCALE

TIME (HRS)	TIME RATIO T/TP	DISCH. RATIO Q/QP	DISCHARGE CFS
.08	.24	.13	202
.17	.52	.51	792
.25	.76	.88	1366
.33	1.0	1.0	1552
.42	1.27	.986	1530
.49	1.48	.930	1443
.58	1.76	.848	1316
.67	2.03	.750	1164
.75	2.27	.652	1012
.83	2.52	.530	823
.92	2.79	.428	664
1.0	3.03	.360	559
1.08	3.27	.312	484
1.17	3.55	.255	396
1.25	3.79	.217	337
1.33	4.03	.182	282
1.42	4.30	.153	237
1.50	4.55	.132	205
1.58	4.79	.111	172
1.67	5.06	.092	143
1.75	5.30	.078	121
1.83	5.55	.065	101
1.92	5.81	.054	84
2.0	6.06	.047	73
2.08	6.30	.040	62
2.17	6.58	.033	51
2.25	6.82	.029	45
2.33	7.06	.026	40
2.42	7.33	.020	31
2.5	7.58	.017	26
2.58	7.82	.015	23
2.67	8.09	.013	20
2.75	8.33	.011	17
2.83	8.58	.010	16
2.92	8.85	.009	14
3.00	9.09	.007	11
3.08	9.33	.006	9
3.17	9.61	.004	6
3.25	9.85	.002	3
3.33	10.09	.001	2
3.50	10.61	.000	0



Anderson-Nichols & Company, Inc.

Subject TAMMOCROWN RESERVOIR

Sheet No. 9 of 11  
 Date 6-1-57  
 Computed EDD  
 Checked EDD

JOB NO. 5290-10

SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30  
 1/4 IN. SCALE

### STAGE-STORAGE DETERMINATIONS

ELEVATION FT	SURFACE AREA ACRES	AVG. SURFACE AREA ACRES	INCREM. STORAGE ACRE-FT	CUMULATIVE STOR. ACRE-FEET
637.5	88.8	88.8	1066 *	1066
640	121	104.9	262	1328
660	369	245	4900	6228

\* assume average depth T-B Reservoir to be 12'

INPUT FOR HEC 1:

ELEVATION	STORAGE
625.5	0
637.5	1066
640	1328
640.5	1395
642	1600
644	1920
646	2280
648	2720
650	3190
655	4550
660	6228

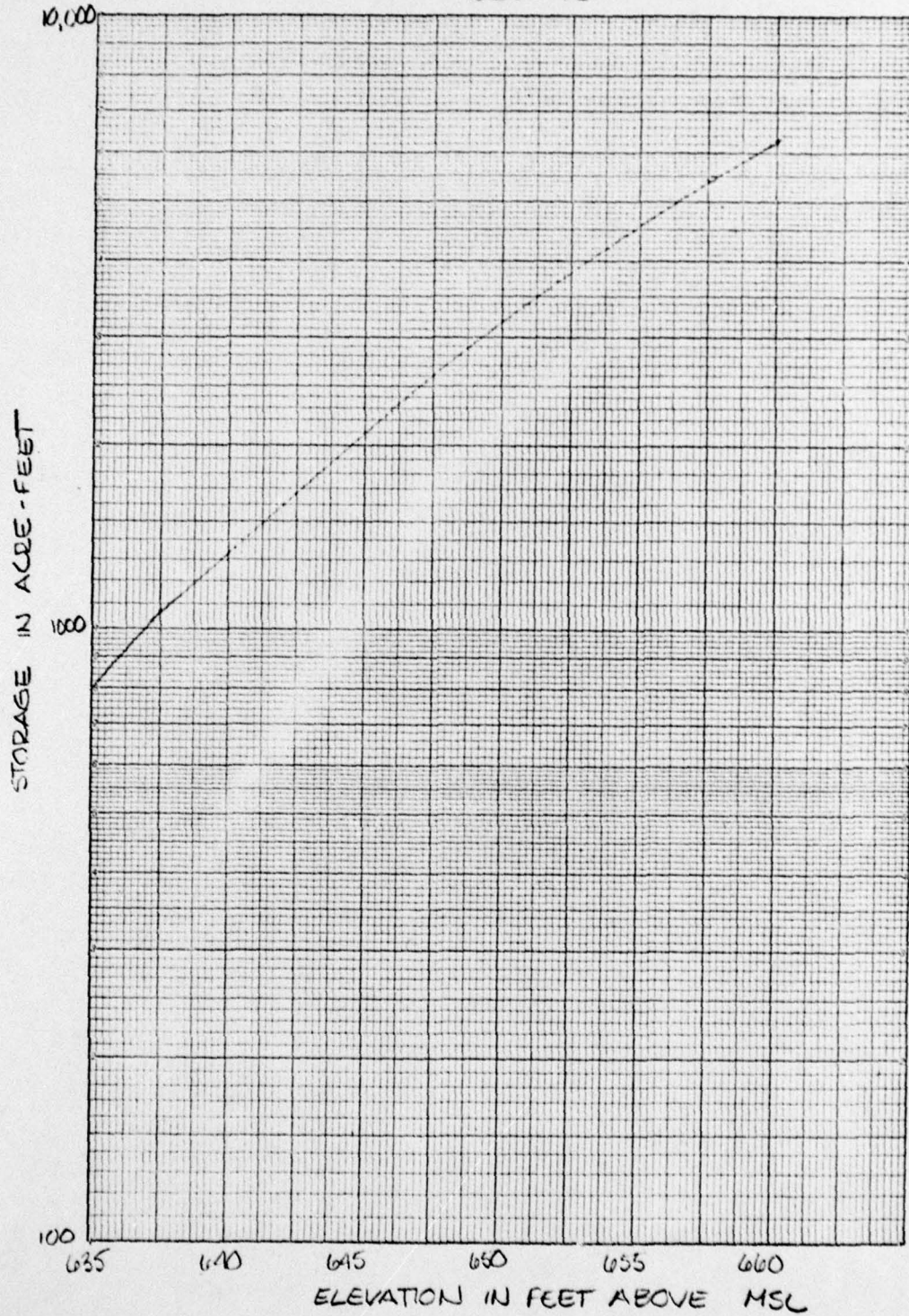
THIS PAGE IS BEST QUALITY PRACTICABLE  
 FROM COPY FURNISHED TO DDC



TAYLORTOWN-BOONTON RESERVOIR  
STORAGE ELEVATION CURVE  
3290-10

10/11

NO. 31.153-R. 30 DIVISIONS PER INCH (120 DIVISIONS) BY TWO 4 1/2-INCH CYCLES RATIO RULING. **CODEX** IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062  
PRINTED IN U.S.A.  
GRAPH PAPER

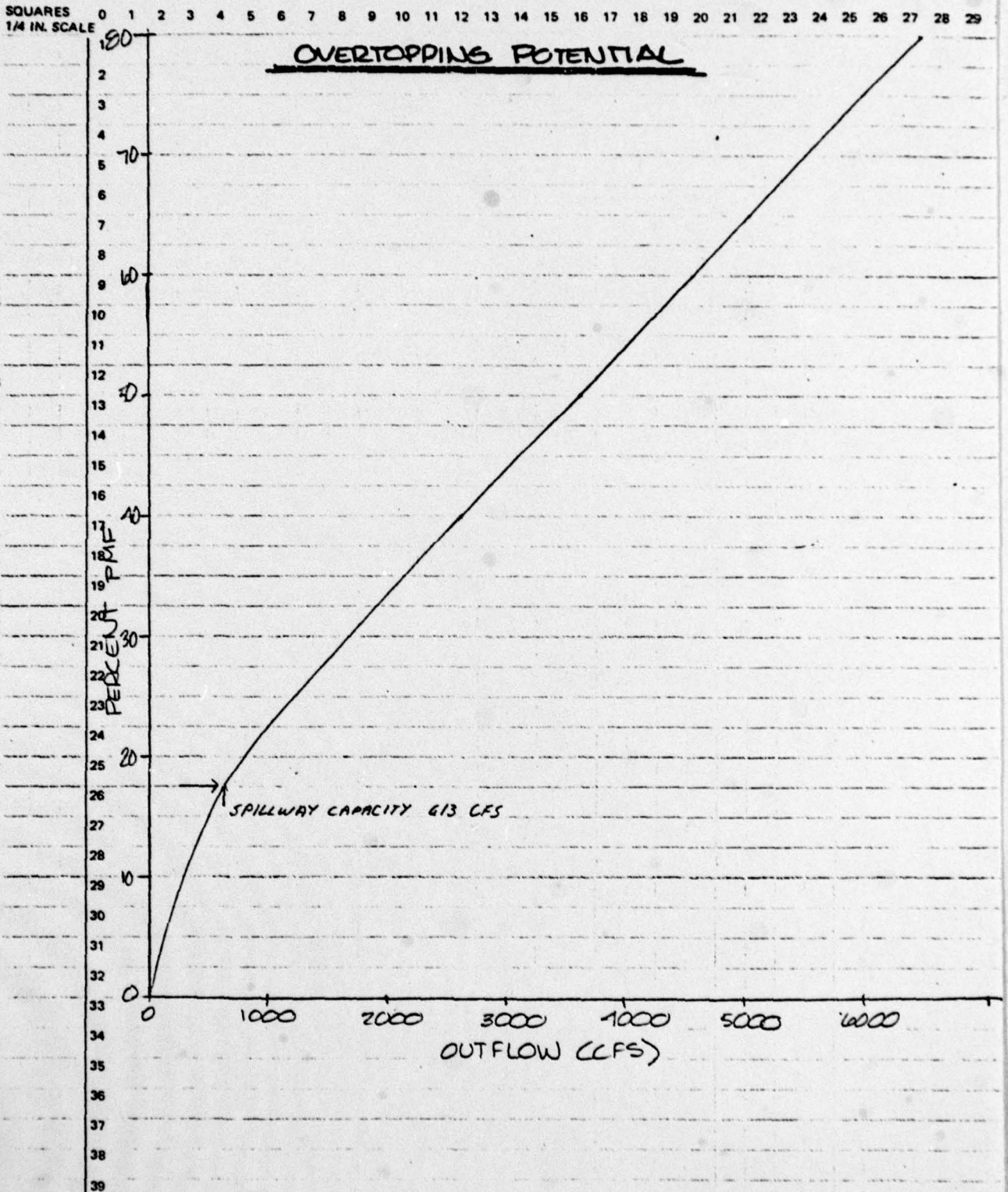


Anderson-Nichols & Company, Inc.

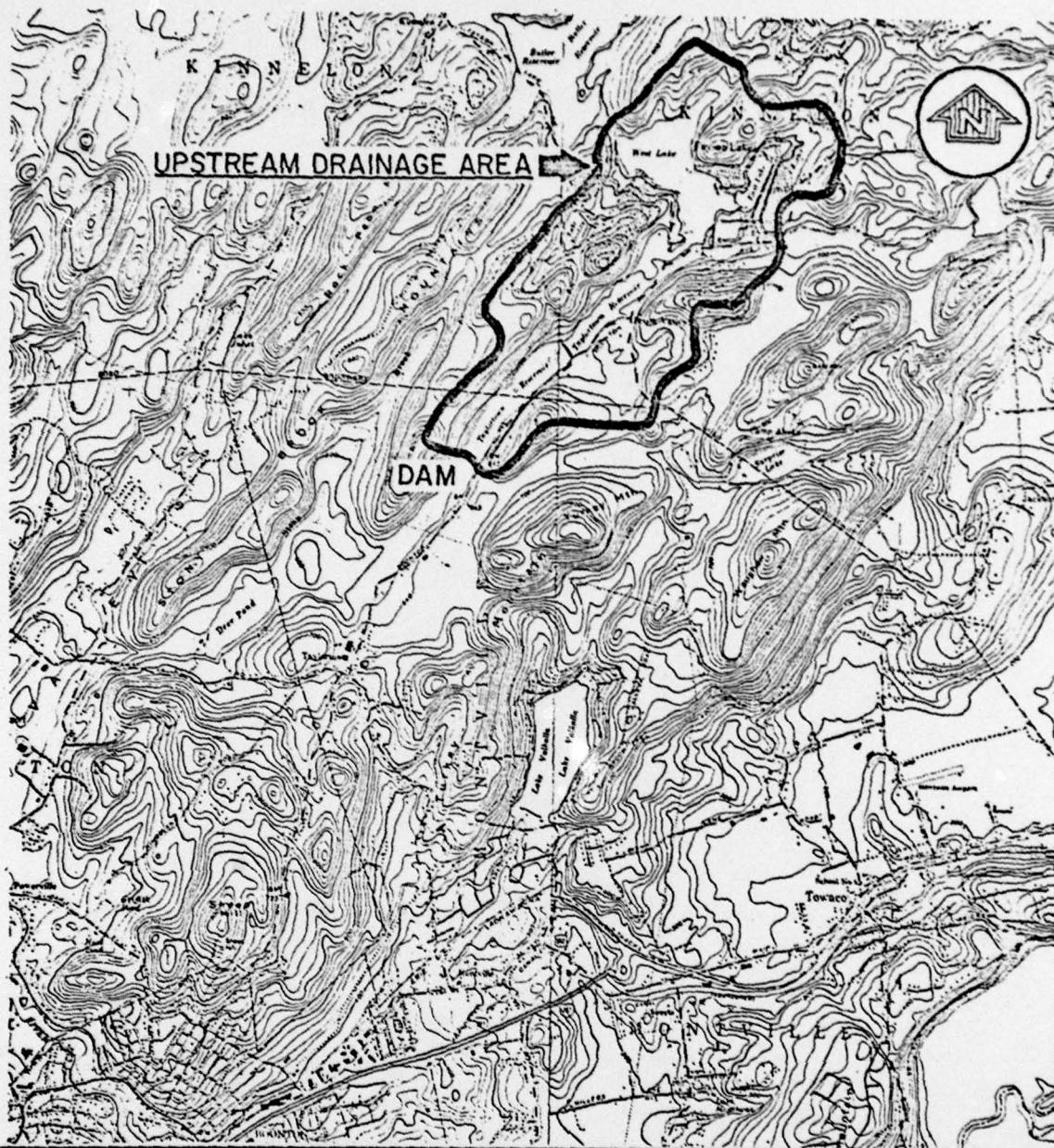
Subject ECONTON RESERVOIR

Sheet No. 11 of 11  
Date 6/6/79  
Computed KAF  
Checked KAF

JOB NO. 3300-10







NATIONAL PROGRAM OF INSPECTION OF  
NON-FED. DAMS

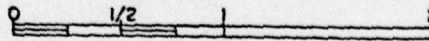
BOONTON RESERVOIR  
MONTVILLE TOWNSHIP, NEW JERSEY  
REGIONAL VICINITY MAP

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC.

BOSTON, MA

SCALE IN MILES



MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE  
SHEETS. BOONTON, N.J., 1954, UPDATED 1970.  
POMPTON PLAINS, N.J., 1955, UPDATED 1970.



HEC-1 OUTPUT

OVERTOPPING ANALYSIS

BOONTON RESERVOIR DAM







PC-DA	HR-PM	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP G	PC-DA	HR-PA	PERIOD	RAIN	EXCS	LOSS	COMP G
1.01	0.05	1	0.17	0.00	0.17	6.0	1.01	5.05	61	0.19	0.18	0.01	4418
1.01	1.10	2	0.17	0.00	0.17	6.0	1.01	5.10	62	0.19	0.18	0.01	4238
1.01	1.15	3	0.17	0.00	0.17	6.0	1.01	5.15	63	0.19	0.18	0.01	4053
1.01	1.20	4	0.17	0.00	0.17	6.0	1.01	5.20	64	0.19	0.18	0.01	3874
1.01	1.25	5	0.17	0.00	0.17	6.0	1.01	5.25	65	0.19	0.18	0.01	3714
1.01	1.30	6	0.17	0.00	0.17	6.0	1.01	5.30	66	0.19	0.18	0.01	3575
1.01	1.35	7	0.17	0.00	0.17	6.0	1.01	5.35	67	0.19	0.18	0.01	3451
1.01	1.40	8	0.17	0.00	0.17	6.0	1.01	5.40	68	0.19	0.18	0.01	3242
1.01	1.45	9	0.17	0.00	0.17	6.0	1.01	5.45	69	0.19	0.18	0.01	3258
1.01	1.50	10	0.17	0.00	0.17	6.0	1.01	5.50	70	0.19	0.18	0.01	3178
1.01	1.55	11	0.17	0.00	0.17	6.0	1.01	5.55	71	0.19	0.18	0.01	3118
1.01	1.60	12	0.17	0.00	0.17	6.0	1.01	5.60	72	0.19	0.18	0.01	3053
1.01	1.65	13	0.17	0.00	0.17	6.0	1.01	5.65	73	0.19	0.00	0.00	2978
1.01	1.70	14	0.17	0.00	0.17	6.0	1.01	5.70	74	0.19	0.00	0.00	2798
1.01	1.75	15	0.17	0.00	0.17	6.0	1.01	5.75	75	0.19	0.00	0.00	2622
1.01	1.80	16	0.17	0.00	0.17	6.0	1.01	5.80	76	0.19	0.00	0.00	2442
1.01	1.85	17	0.17	0.00	0.17	6.0	1.01	5.85	77	0.19	0.00	0.00	2222
1.01	1.90	18	0.17	0.00	0.17	6.0	1.01	5.90	78	0.19	0.00	0.00	1922
1.01	1.95	19	0.17	0.00	0.17	6.0	1.01	5.95	79	0.19	0.00	0.00	1648
1.01	2.00	20	0.17	0.00	0.17	6.0	1.01	6.00	80	0.19	0.00	0.00	1388
1.01	2.05	21	0.17	0.00	0.17	6.0	1.01	6.05	81	0.19	0.00	0.00	1168
1.01	2.10	22	0.17	0.00	0.17	6.0	1.01	6.10	82	0.19	0.00	0.00	962
1.01	2.15	23	0.17	0.00	0.17	6.0	1.01	6.15	83	0.19	0.00	0.00	802
1.01	2.20	24	0.17	0.00	0.17	6.0	1.01	6.20	84	0.19	0.00	0.00	672
1.01	2.25	25	0.17	0.00	0.17	6.0	1.01	6.25	85	0.19	0.00	0.00	562
1.01	2.30	26	0.17	0.00	0.17	6.0	1.01	6.30	86	0.19	0.00	0.00	472
1.01	2.35	27	0.17	0.00	0.17	6.0	1.01	6.35	87	0.19	0.00	0.00	402
1.01	2.40	28	0.17	0.00	0.17	6.0	1.01	6.40	88	0.19	0.00	0.00	332
1.01	2.45	29	0.17	0.00	0.17	6.0	1.01	6.45	89	0.19	0.00	0.00	282
1.01	2.50	30	0.17	0.00	0.17	6.0	1.01	6.50	90	0.19	0.00	0.00	242
1.01	2.55	31	0.17	0.00	0.17	6.0	1.01	6.55	91	0.19	0.00	0.00	202
1.01	2.60	32	0.17	0.00	0.17	6.0	1.01	6.60	92	0.19	0.00	0.00	172
1.01	2.65	33	0.17	0.00	0.17	6.0	1.01	6.65	93	0.19	0.00	0.00	142
1.01	2.70	34	0.17	0.00	0.17	6.0	1.01	6.70	94	0.19	0.00	0.00	112
1.01	2.75	35	0.17	0.00	0.17	6.0	1.01	6.75	95	0.19	0.00	0.00	82
1.01	2.80	36	0.17	0.00	0.17	6.0	1.01	6.80	96	0.19	0.00	0.00	52
1.01	2.85	37	0.17	0.00	0.17	6.0	1.01	6.85	97	0.19	0.00	0.00	22
1.01	2.90	38	0.17	0.00	0.17	6.0	1.01	6.90	98	0.19	0.00	0.00	0
1.01	2.95	39	0.17	0.00	0.17	6.0	1.01	6.95	99	0.19	0.00	0.00	0
1.01	3.00	40	0.17	0.00	0.17	6.0	1.01	7.00	100	0.19	0.00	0.00	0
1.01	3.05	41	0.17	0.00	0.17	6.0	1.01	7.05	101	0.19	0.00	0.00	0
1.01	3.10	42	0.17	0.00	0.17	6.0	1.01	7.10	102	0.19	0.00	0.00	0
1.01	3.15	43	0.17	0.00	0.17	6.0	1.01	7.15	103	0.19	0.00	0.00	0
1.01	3.20	44	0.17	0.00	0.17	6.0	1.01	7.20	104	0.19	0.00	0.00	0
1.01	3.25	45	0.17	0.00	0.17	6.0	1.01	7.25	105	0.19	0.00	0.00	0
1.01	3.30	46	0.17	0.00	0.17	6.0	1.01	7.30	106	0.19	0.00	0.00	0
1.01	3.35	47	0.17	0.00	0.17	6.0	1.01	7.35	107	0.19	0.00	0.00	0
1.01	3.40	48	0.17	0.00	0.17	6.0	1.01	7.40	108	0.19	0.00	0.00	0
1.01	3.45	49	0.17	0.00	0.17	6.0	1.01	7.45	109	0.19	0.00	0.00	0
1.01	3.50	50	0.17	0.00	0.17	6.0	1.01	7.50	110	0.19	0.00	0.00	0
1.01	3.55	51	0.17	0.00	0.17	6.0	1.01	7.55	111	0.19	0.00	0.00	0
1.01	3.60	52	0.17	0.00	0.17	6.0	1.01	7.60	112	0.19	0.00	0.00	0
1.01	3.65	53	0.17	0.00	0.17	6.0	1.01	7.65	113	0.19	0.00	0.00	0
1.01	3.70	54	0.17	0.00	0.17	6.0	1.01	7.70	114	0.19	0.00	0.00	0
1.01	3.75	55	0.17	0.00	0.17	6.0	1.01	7.75	115	0.19	0.00	0.00	0
1.01	3.80	56	0.17	0.00	0.17	6.0	1.01	7.80	116	0.19	0.00	0.00	0
1.01	3.85	57	0.17	0.00	0.17	6.0	1.01	7.85	117	0.19	0.00	0.00	0
1.01	3.90	58	0.17	0.00	0.17	6.0	1.01	7.90	118	0.19	0.00	0.00	0
1.01	3.95	59	0.17	0.00	0.17	6.0	1.01	7.95	119	0.19	0.00	0.00	0
1.01	4.00	60	0.17	0.00	0.17	6.0	1.01	8.00	120	0.19	0.00	0.00	0
1.01	4.05	61	0.17	0.00	0.17	6.0	1.01	8.05	121	0.19	0.00	0.00	0
1.01	4.10	62	0.17	0.00	0.17	6.0	1.01	8.10	122	0.19	0.00	0.00	0
1.01	4.15	63	0.17	0.00	0.17	6.0	1.01	8.15	123	0.19	0.00	0.00	0
1.01	4.20	64	0.17	0.00	0.17	6.0	1.01	8.20	124	0.19	0.00	0.00	0
1.01	4.25	65	0.17	0.00	0.17	6.0	1.01	8.25	125	0.19	0.00	0.00	0
1.01	4.30	66	0.17	0.00	0.17	6.0	1.01	8.30	126	0.19	0.00	0.00	0
1.01	4.35	67	0.17	0.00	0.17	6.0	1.01	8.35	127	0.19	0.00	0.00	0
1.01	4.40	68	0.17	0.00	0.17	6.0	1.01	8.40	128	0.19	0.00	0.00	0
1.01	4.45	69	0.17	0.00	0.17	6.0	1.01	8.45	129	0.19	0.00	0.00	0
1.01	4.50	70	0.17	0.00	0.17	6.0	1.01	8.50	130	0.19	0.00	0.00	0
1.01	4.55	71	0.17	0.00	0.17	6.0	1.01	8.55	131	0.19	0.00	0.00	0
1.01	4.60	72	0.17	0.00	0.17	6.0	1.01	8.60	132	0.19	0.00	0.00	0
1.01	4.65	73	0.17	0.00	0.17	6.0	1.01	8.65	133	0.19	0.00	0.00	0
1.01	4.70	74	0.17	0.00	0.17	6.0	1.01	8.70	134	0.19	0.00	0.00	0
1.01	4.75	75	0.17	0.00	0.17	6.0	1.01	8.75	135	0.19	0.00	0.00	0
1.01	4.80	76	0.17	0.00	0.17	6.0	1.01	8.80	136	0.19	0.00	0.00	0
1.01	4.85	77	0.17	0.00	0.17	6.0	1.01	8.85	137	0.19	0.00	0.00	0
1.01	4.90	78	0.17	0.00	0.17	6.0	1.01	8.90	138	0.19	0.00	0.00	0
1.01	4.95	79	0.17	0.00	0.17	6.0	1.01	8.95	139	0.19	0.00	0.00	0
1.01	5.00	80	0.17	0.00	0.17	6.0	1.01	9.00	140	0.19	0.00	0.00	0
1.01	5.05	81	0.17	0.00	0.17	6.0	1.01	9.05	141	0.19	0.00	0.00	0
1.01	5.10	82	0.17	0.00	0.17	6.0	1.01	9.10	142	0.19	0.00	0.00	0
1.01	5.15	83	0.17	0.00	0.17	6.0	1.01	9.15	143	0.19	0.00	0.00	0
1.01	5.20	84	0.17	0.00	0.17	6.0	1.01	9.20	144	0.19	0.00	0.00	0
1.01	5.25	85	0.17	0.00	0.17	6.0	1.01	9.25	145	0.19	0.00	0.00	0
1.01	5.30	86	0.17	0.00	0.17	6.0	1.01	9.30	146	0.19	0.00	0.00	0
1.01	5.35	87	0.17	0.00	0.17	6.0	1.01	9.35	147	0.19	0.00	0.00	0
1.01	5.40	88	0.17	0.00	0.17	6.0	1.01	9.40	148	0.19	0.00	0.00	0
1.01	5.45	89	0.17	0.00	0.17	6.0	1.01	9.45	149	0.19	0.00	0.00	0
1.01	5.50	90	0.17	0.00	0.17	6.0	1.01	9.50	150	0.19	0.00	0.00	0
1.01	5.55	91	0.17	0.00	0.17	6.0	1.01	9.55	151	0.19	0.00	0.00	0
1.01	5.60	92	0.17	0.00	0.17	6.0	1.01	9.60	152	0.19	0.00	0.00	0
1.01	5.65	93	0.17	0.00	0.17	6.0	1.01	9.65	153	0.19	0.00	0.00	0
1.01	5.70	94	0.17	0.00	0.17	6.0	1.01	9.70	154	0.19	0.00	0.00	0
1.01	5.75	95	0.17	0.00	0.17	6.0	1.01	9.75	155	0.19	0.00	0.00	0
1.01	5.80	96	0.17	0.00	0.17	6.0	1.01	9.80	156	0.19	0.00	0.00	0
1.01	5.85	97	0.17	0.00	0.17	6.0	1.01	9.85	157	0.19	0.00	0.00	0
1.01	5.90	98	0.17	0.00	0.17	6.0	1.01	9.90	158	0.19	0.00	0.00	0
1.01	5.95	99	0.17	0.00									





STATION A2. PLAN 1: RATIO 3  
 EMB-CF-PEPICU HYDROGRAPH CCEINATES

OUTFLOW									
0.	1.	2.	3.	4.	5.	6.	7.	8.	9.
12.	29.	41.	55.	71.	86.	100.	112.	122.	131.
13.	217.	246.	263.	286.	309.	330.	350.	368.	384.
43.	459.	485.	511.	537.	563.	589.	615.	640.	665.
89.	1038.	1215.	1403.	1581.	1759.	1937.	2115.	2293.	2471.
359.	505.	559.	613.	667.	721.	775.	829.	883.	937.
706.	774.	842.	910.	978.	1046.	1114.	1182.	1250.	1318.
1201.	1200.	1199.	1198.	1197.	1196.	1195.	1194.	1193.	1192.
1191.	1190.	1189.	1188.	1187.	1186.	1185.	1184.	1183.	1182.
1181.	1180.	1179.	1178.	1177.	1176.	1175.	1174.	1173.	1172.
1171.	1170.	1169.	1168.	1167.	1166.	1165.	1164.	1163.	1162.
1161.	1160.	1159.	1158.	1157.	1156.	1155.	1154.	1153.	1152.
1151.	1150.	1149.	1148.	1147.	1146.	1145.	1144.	1143.	1142.
1141.	1140.	1139.	1138.	1137.	1136.	1135.	1134.	1133.	1132.
1131.	1130.	1129.	1128.	1127.	1126.	1125.	1124.	1123.	1122.
1121.	1120.	1119.	1118.	1117.	1116.	1115.	1114.	1113.	1112.
1111.	1110.	1109.	1108.	1107.	1106.	1105.	1104.	1103.	1102.
1101.	1100.	1099.	1098.	1097.	1096.	1095.	1094.	1093.	1092.
1091.	1090.	1089.	1088.	1087.	1086.	1085.	1084.	1083.	1082.
1081.	1080.	1079.	1078.	1077.	1076.	1075.	1074.	1073.	1072.
1071.	1070.	1069.	1068.	1067.	1066.	1065.	1064.	1063.	1062.
1061.	1060.	1059.	1058.	1057.	1056.	1055.	1054.	1053.	1052.
1051.	1050.	1049.	1048.	1047.	1046.	1045.	1044.	1043.	1042.
1041.	1040.	1039.	1038.	1037.	1036.	1035.	1034.	1033.	1032.
1031.	1030.	1029.	1028.	1027.	1026.	1025.	1024.	1023.	1022.
1021.	1020.	1019.	1018.	1017.	1016.	1015.	1014.	1013.	1012.
1011.	1010.	1009.	1008.	1007.	1006.	1005.	1004.	1003.	1002.
1001.	1000.	999.	998.	997.	996.	995.	994.	993.	992.
991.	990.	989.	988.	987.	986.	985.	984.	983.	982.
981.	980.	979.	978.	977.	976.	975.	974.	973.	972.
971.	970.	969.	968.	967.	966.	965.	964.	963.	962.
961.	960.	959.	958.	957.	956.	955.	954.	953.	952.
951.	950.	949.	948.	947.	946.	945.	944.	943.	942.
941.	940.	939.	938.	937.	936.	935.	934.	933.	932.
931.	930.	929.	928.	927.	926.	925.	924.	923.	922.
921.	920.	919.	918.	917.	916.	915.	914.	913.	912.
911.	910.	909.	908.	907.	906.	905.	904.	903.	902.
901.	900.	899.	898.	897.	896.	895.	894.	893.	892.
891.	890.	889.	888.	887.	886.	885.	884.	883.	882.
881.	880.	879.	878.	877.	876.	875.	874.	873.	872.
871.	870.	869.	868.	867.	866.	865.	864.	863.	862.
861.	860.	859.	858.	857.	856.	855.	854.	853.	852.
851.	850.	849.	848.	847.	846.	845.	844.	843.	842.
841.	840.	839.	838.	837.	836.	835.	834.	833.	832.
831.	830.	829.	828.	827.	826.	825.	824.	823.	822.
821.	820.	819.	818.	817.	816.	815.	814.	813.	812.
811.	810.	809.	808.	807.	806.	805.	804.	803.	802.
801.	800.	799.	798.	797.	796.	795.	794.	793.	792.
791.	790.	789.	788.	787.	786.	785.	784.	783.	782.
781.	780.	779.	778.	777.	776.	775.	774.	773.	772.
771.	770.	769.	768.	767.	766.	765.	764.	763.	762.
761.	760.	759.	758.	757.	756.	755.	754.	753.	752.
751.	750.	749.	748.	747.	746.	745.	744.	743.	742.
741.	740.	739.	738.	737.	736.	735.	734.	733.	732.
731.	730.	729.	728.	727.	726.	725.	724.	723.	722.
721.	720.	719.	718.	717.	716.	715.	714.	713.	712.
711.	710.	709.	708.	707.	706.	705.	704.	703.	702.
701.	700.	699.	698.	697.	696.	695.	694.	693.	692.
691.	690.	689.	688.	687.	686.	685.	684.	683.	682.
681.	680.	679.	678.	677.	676.	675.	674.	673.	672.
671.	670.	669.	668.	667.	666.	665.	664.	663.	662.
661.	660.	659.	658.	657.	656.	655.	654.	653.	652.
651.	650.	649.	648.	647.	646.	645.	644.	643.	642.
641.	640.	639.	638.	637.	636.	635.	634.	633.	632.
631.	630.	629.	628.	627.	626.	625.	624.	623.	622.
621.	620.	619.	618.	617.	616.	615.	614.	613.	612.
611.	610.	609.	608.	607.	606.	605.	604.	603.	602.
601.	600.	599.	598.	597.	596.	595.	594.	593.	592.
591.	590.	589.	588.	587.	586.	585.	584.	583.	582.
581.	580.	579.	578.	577.	576.	575.	574.	573.	572.
571.	570.	569.	568.	567.	566.	565.	564.	563.	562.
561.	560.	559.	558.	557.	556.	555.	554.	553.	552.
551.	550.	549.	548.	547.	546.	545.	544.	543.	542.
541.	540.	539.	538.	537.	536.	535.	534.	533.	532.
531.	530.	529.	528.	527.	526.	525.	524.	523.	522.
521.	520.	519.	518.	517.	516.	515.	514.	513.	512.
511.	510.	509.	508.	507.	506.	505.	504.	503.	502.
501.	500.	499.	498.	497.	496.	495.	494.	493.	492.
491.	490.	489.	488.	487.	486.	485.	484.	483.	482.
481.	480.	479.	478.	477.	476.	475.	474.	473.	472.
471.	470.	469.	468.	467.	466.	465.	464.	463.	462.
461.	460.	459.	458.	457.	456.	455.	454.	453.	452.
451.	450.	449.	448.	447.	446.	445.	444.	443.	442.
441.	440.	439.	438.	437.	436.	435.	434.	433.	432.
431.	430.	429.	428.	427.	426.	425.	424.	423.	422.
421.	420.	419.	418.	417.	416.	415.	414.	413.	412.
411.	410.	409.	408.	407.	406.	405.	404.	403.	402.
401.	400.	399.	398.	397.	396.	395.	394.	393.	392.
391.	390.	389.	388.	387.	386.	385.	384.	383.	382.
381.	380.	379.	378.	377.	376.	375.	374.	373.	372.
371.	370.	369.	368.	367.	366.	365.	364.	363.	362.
361.	360.	359.	358.	357.	356.	355.	354.	353.	352.
351.	350.	349.	348.	347.	346.	345.	344.	343.	342.
341.	340.	339.	338.	337.	336.	335.	334.	333.	332.
331.	330.	329.	328.	327.	326.	325.	324.	323.	322.
321.	320.	319.	318.	317.	316.	315.	314.	313.	312.
311.	310.	309.	308.	307.	306.	305.	304.	303.	302.
301.	300.	299.	298.	297.	296.	295.	294.	293.	292.
291.	290.	289.	288.	287.	286.	285.	284.	283.	282.
281.	280.	279.	278.	277.	276.	275.	274.	273.	272.
271.	270.	269.	268.	267.	266.	265.	264.	263.	262.
261.	260.	259.	258.	257.	256.	255.	254.	253.	252.
251.	250.	249.	248.	247.	246.	245.	244.	243.	242.
241.	240.	239.	238.	237.	236.	235.	234.	233.	232.
231.	230.	229.	228.	227.	226.	225.	224.	223.	222.
221.	220.	219.	218.	217.	216.	215.	214.	213.	212.
211.	210.	209.	208.	207.	206.	205.	204.	203.	202.
201.	200.	199.	198.	197.	196.	195.	194.	193.	192.
191.	190.	189.	188.	187.	186.	185.	184.	183.	182.
181.	180.	179.	178.	177.	176.	175.	174.	173.	172.
171.	170.	169.	168.	167.	166.	165.	164.	163.	162.
161.	160.	159.	158.	157.	156.	155.	154.	153.	152.
151.	150.	149.	148.	147.	146.	145.	144.	143.	142.
141.	140.	139.	138.	137.	136.	135.	134.	133.	132.
131.	130.	129.	128.	127.	126.	125.	124.	123.	122.
121.	120.	119.	118.	117.	116.	115.	114.	113.	112.
111.	110.	109.	108.	107.	106.	105.	104.	103.	102.
101.	100.	99.	98.	97.	96.	95.	94.	93.	92.
91.	90.	89.	88.	87.	86.	85.	84.	83.	82.
81.	80.	79.	78.	77.	76.	75.	74.	73.	72.
71.	70.	69.	68.	67.	66.	65.	64.	63.	62.
61.	60.	59.	58.	57.	56.	55.	54.	53.	52.
51.	50.	49.	48.	47.	46.	45.	44.	43.	42.
41.	40.	39.	38.	37.	36.	35.	34.	33.	32.
31.	30.	29.	28.	27.	26.	25.	24.	23.	22.
21.	20.	19.	18.	17.	16.	15.	14.	13.	12.
11.	10.	9.	8.	7.	6.	5.	4.	3.	2.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PEAK OUTFLOW IS 3597. AT TIME 4.42 HOURS

PEAK	4-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
3597.	1643.	1077.	1078.	12335.
102.	47.	31.	31.	2663.
	7.64	8.36	8.36	8.76
	198.14	212.27	212.27	212.27
	815.	815.	815.	891.
	1005.	1005.	1005.	1005.

THIS PAGE IS BEST QUALITY PRACTICABLE  
 FROM COPY FURNISHED TO DDC



STATION A2, PLAT 1, RATIO 5  
END-OF-PERIOD HYDROGRAPH COORDINATES

OUTFLOW									
0.	0.	0.	0.	1.	1.	1.	1.	10.	21.
37.	57.	95.	111.	143.	170.	216.	285.	399.	513.
100.	133.	177.	228.	271.	331.	799.	1043.	1371.	1512.
1710.	1909.	2096.	2246.	2399.	2536.	2761.	2993.	3114.	3085.
3345.	3568.	3668.	4023.	4761.	5635.	6482.	7250.	7796.	8158.
1260.	8221.	8049.	7787.	7478.	7116.	6477.	6172.	5911.	5981.
5660.	5429.	5206.	4950.	4722.	4504.	4378.	4226.	4051.	3954.
3845.	3735.	3631.	3520.	3398.	3260.	3099.	2891.	2692.	2530.
2384.	2156.	2023.	1871.	1718.	1573.	1475.	1306.	1184.	1072.
969.	935.	893.	752.	704.	659.	616.	602.	591.	580.
568.	534.	504.	536.	526.	535.	505.	495.	485.	475.
465.	456.	441.	476.	429.	420.	412.	403.	395.	387.

STORAGE			
1055	1056	1057	1058
1059	1060	1061	1062
1063	1064	1065	1066
1067	1068	1069	1070
1071	1072	1073	1074
1075	1076	1077	1078
1079	1080	1081	1082
1083	1084	1085	1086
1087	1088	1089	1090
1091	1092	1093	1094
1095	1096	1097	1098
1099	1100	1101	1102
1103	1104	1105	1106
1107	1108	1109	1110
1111	1112	1113	1114
1115	1116	1117	1118
1119	1120	1121	1122
1123	1124	1125	1126
1127	1128	1129	1130
1131	1132	1133	1134
1135	1136	1137	1138
1139	1140	1141	1142
1143	1144	1145	1146
1147	1148	1149	1150
1151	1152	1153	1154
1155	1156	1157	1158
1159	1160	1161	1162
1163	1164	1165	1166
1167	1168	1169	1170
1171	1172	1173	1174
1175	1176	1177	1178
1179	1180	1181	1182
1183	1184	1185	1186
1187	1188	1189	1190
1191	1192	1193	1194
1195	1196	1197	1198
1199	1200	1201	1202
1203	1204	1205	1206
1207	1208	1209	1210
1211	1212	1213	1214
1215	1216	1217	1218
1219	1220	1221	1222
1223	1224	1225	1226
1227	1228	1229	1230
1231	1232	1233	1234
1235	1236	1237	1238
1239	1240	1241	1242
1243	1244	1245	1246
1247	1248	1249	1250
1251	1252	1253	1254
1255	1256	1257	1258
1259	1260	1261	1262
1263	1264	1265	1266
1267	1268	1269	1270
1271	1272	1273	1274
1275	1276	1277	1278
1279	1280	1281	1282
1283	1284	1285	1286
1287	1288	1289	1290
1291	1292	1293	1294
1295	1296	1297	1298
1299	1300	1301	1302
1303	1304	1305	1306
1307	1308	1309	1310
1311	1312	1313	1314
1315	1316	1317	1318
1319	1320	1321	1322
1323	1324	1325	1326
1327	1328	1329	1330
1331	1332	1333	1334
1335	1336	1337	1338
1339	1340	1341	1342
1343	1344	1345	1346
1347	1348	1349	1350
1351	1352	1353	1354
1355	1356	1357	1358
1359	1360	1361	1362
1363	1364	1365	1366
1367	1368	1369	1370
1371	1372	1373	1374
1375	1376	1377	1378
1379	1380	1381	1382
1383	1384	1385	1386
1387	1388	1389	1390
1391	1392	1393	1394
1395	1396	1397	1398
1399	1400	1401	1402
1403	1404	1405	1406
1407	1408	1409	1410
1411	1412	1413	1414
1415	1416	1417	1418
1419	1420	1421	1422
1423	1424	1425	1426
1427	1428	1429	1430
1431	1432	1433	1434
1435	1436	1437	1438
1439	1440	1441	1442
1443	1444	1445	1446
1447	1448	1449	1450
1451	1452	1453	1454
1455	1456	1457	1458
1459	1460	1461	1462
1463	1464	1465	1466
1467	1468	1469	1470
1471	1472	1473	1474
1475	1476	1477	1478
1479	1480	1481	1482
1483	1484	1485	1486
1487	1488	1489	1490
1491	1492	1493	1494
1495	1496	1497	1498
1499	1500	1501	1502
1503	1504	1505	1506
1507	1508	1509	1510
1511	1512	1513	1514
1515	1516	1517	1518
1519	1520	1521	1522
1523	1524	1525	1526
1527	1528	1529	1530
1531	1532	1533	1534
1535	1536	1537	1538
1539	1540	1541	1542
1543	1544	1545	1546
1547	1548	1549	1550
1551	1552	1553	1554
1555	1556	1557	1558
1559	1560	1561	1562
1563	1564	1565	1566
1567	1568	1569	1570
1571	1572	1573	1574
1575	1576	1577	1578
1579	1580	1581	1582
1583	1584	1585	1586
1587	1588	1589	1590
1591	1592	1593	1594
1595	1596	1597	1598
1599	1600	1601	1602
1603	1604	1605	1606
1607	1608	1609	1610
1611	1612	1613	1614
1615	1616	1617	1618
1619	1620	1621	1622
1623	1624	1625	1626
1627	1628	1629	1630
1631	1632	1633	1634
1635	1636	1637	1638
1639	1640	1641	1642
1643	1644	1645	1646
1647	1648	1649	1650
1651	1652	1653	1654
1655	1656	1657	1658
1659	1660	1661	1662
1663	1664	1665	1666
1667	1668	1669	1670
1671	1672	1673	1674
1675	1676	1677	1678
1679	1680	1681	1682
1683	1684	1685	1686
1687	1688	1689	1690
1691	1692	1693	1694
1695	1696	1697	1698
1699	1700	1701	1702
1703	1704	1705	1706
1707	1708	1709	1710
1711	1712	1713	1714
1715	1716	1717	1718
1719	1720	1721	1722
1723	1724	1725	1726
1727	1728	1729	1730
1731	1732	1733	1734
1735	1736	1737	1738
1739	1740	1741	1742
1743	1744	1745	1746
1747	1748	1749	1750
1751	1752	1753	1754
1755	1756	1757	1758
1759	1760	1761	1762
1763	1764	1765	1766
1767	1768	1769	1770
1771	1772	1773	1774
1775	1776	1777	1778
1779	1780	1781	1782
1783	1784	1785	1786
1787	1788	1789	1790
1791	1792	1793	1794
1795	1796	1797	1798
1799	1800	1801	1802
1803	1804	1805	1806
1807	1808	1809	1810
1811	1812	1813	1814
1815	1816	1817	1818
1819	1820	1821	1822
1823	1824	1825	1826
1827	1828	1829	1830
1831	1832	1833	1834
1835	1836	1837	1838
1839	1840	1841	1842
1843	1844	1845	1846
1847	1848	1849	1850
1851	1852	1853	1854
1855	1856	1857	1858
1859	1860	1861	1862
1863	1864	1865	1866
1867	1868	1869	1870
1871	1872	1873	1874
1875	1876	1877	1878
1879	1880	1881	1882
1883	1884	1885	1886
1887	1888	1889	1890
1891	1892	1893	1894
1895	1896	1897	1898
1899	1900	1901	1902
1903	1904	1905	1906
1907	1908	1909	1910
1911	1912	1913	1914
1915	1916	1917	1918
1919	1920	1921	1922
1923	1924	1925	1926
1927	1928	1929	1930
1931	1932	1933	1934
1935	1936	1937	1938
1939	1940	1941	1942
1943	1944	1945	1946
1947	1948	1949	1950
1951	1952	1953	1954
1955	1956	1957	1958
1959	1960	1961	1962
1963	1964	1965	1966
1967	1968	1969	1970
1971	1972	1973	1974
1975	1976	1977	1978
1979	1980	1981	1982
1983	1984	1985	1986
1987	1988	1989	1990
1991	1992	1993	1994
1995	1996	1997	1998
1999	2000	2001	2002
2003	2004	2005	2006
2007	2008	2009	2010
2011	2012	2013	2014
2015	2016	2017	2018
2019	2020	2021	2022
2023	2024	2025	2026
2027	2028	2029	2030
2031	2032	2033	2034
2035	2036	2037	2038
2039	2040	2041	2042
2043	2044	2045	2046
2047	2048	2049	2050
2051	2052	2053	2054
2055	2056	2057	2058
2059	2060	2061	2062
2063	2064	2065	2066
2067	2068	2069	2070
2071	2072	2073	2074
2075	2076	2077	2078
2079	2080	2081	2082
2083	2084	2085	2086
2087	2088	2089	2090
2091	2092	2093	2094
2095	2096	2097	2098
2099	2100	2101	2102
2103	2104	2105	2106
2107	2108	2109	2110
2111	2112	2113	2114
2115	2116	2117	2118
2119	2120	2121	2122
2123	2124	2125	2126
2127	2128	2129	2130
2131	2132	2133	2134
2135	2136	2137	2138
2139	2140	2141	2142
2143	2144	2145	2146
2147	2148	2149	2150
2151	2152	2153	2154
2155	2156	2157	2158
2159	2160	2161	2162
2163	2164	2165	2166
2167	2168	2169	2170
2171	2172	2173	2174
2175	2176	2177	2178
2179	2180	2181	2182
2183	2184	2185	2186
2187	2188	2189	2190
2191	2192	2193	2194
2195	2196	2197	2198
2199	2200	2201	2202
2203	2204	2205	2206
2207	2208	2209	2210
2211	2212	2213	2214
2215	2216	2217	2218
2219	2220	2221	2222
2223	2224	2225	2226
2227	2228	2229	2230
2231	2232	2233	2234
2235	2236	2237	2238
2239	2240	2241	2242
2243	2244	2245	2246
2247	2248	2249	2250
2251	2252	2253	2254
2255	2256	2257	2258
2259	2260	2261	2262
2263	2264	2265	2266
2267	2268	2269	2270
2271	2272	2273	2274
2275	2276	2277	2278
2279	2280	2281	2282
2283	2284	2285	2286
2287	2288	2289	2290
2291			

STATE	
637.5	637.5
637.6	637.6
637.7	637.7
637.8	637.8
637.9	637.9
638.0	638.0
638.1	638.1
638.2	638.2
638.3	638.3
638.4	638.4
638.5	638.5
638.6	638.6
638.7	638.7
638.8	638.8
638.9	638.9
639.0	639.0
639.1	639.1
639.2	639.2
639.3	639.3
639.4	639.4
639.5	639.5
639.6	639.6
639.7	639.7
639.8	639.8
639.9	639.9
640.0	640.0
640.1	640.1
640.2	640.2
640.3	640.3
640.4	640.4
640.5	640.5
640.6	640.6
640.7	640.7
640.8	640.8
640.9	640.9
641.0	641.0
641.1	641.1
641.2	641.2
641.3	641.3
641.4	641.4
641.5	641.5
641.6	641.6
641.7	641.7
641.8	641.8
641.9	641.9
642.0	642.0
642.1	642.1
642.2	642.2
642.3	642.3
642.4	642.4
642.5	642.5
642.6	642.6
642.7	642.7
642.8	642.8
642.9	642.9
643.0	643.0
643.1	643.1
643.2	643.2
643.3	643.3
643.4	643.4
643.5	643.5
643.6	643.6
643.7	643.7
643.8	643.8
643.9	643.9
644.0	644.0
644.1	644.1
644.2	644.2
644.3	644.3
644.4	644.4
644.5	644.5
644.6	644.6
644.7	644.7
644.8	644.8
644.9	644.9
645.0	645.0
645.1	645.1
645.2	645.2
645.3	645.3
645.4	645.4
645.5	645.5
645.6	645.6
645.7	645.7
645.8	645.8
645.9	645.9
646.0	646.0
646.1	646.1
646.2	646.2
646.3	646.3
646.4	646.4
646.5	646.5
646.6	646.6
646.7	646.7
646.8	646.8
646.9	646.9
647.0	647.0
647.1	647.1
647.2	647.2
647.3	647.3
647.4	647.4
647.5	647.5
647.6	647.6
647.7	647.7
647.8	647.8
647.9	647.9
648.0	648.0
648.1	648.1
648.2	648.2
648.3	648.3
648.4	648.4
648.5	648.5
648.6	648.6
648.7	648.7
648.8	648.8
648.9	648.9
649.0	649.0
649.1	649.1
649.2	649.2
649.3	649.3
649.4	649.4
649.5	649.5
649.6	649.6
649.7	649.7
649.8	649.8
649.9	649.9
650.0	650.0
650.1	650.1
650.2	650.2
650.3	650.3
650.4	650.4
650.5	650.5
650.6	650.6
650.7	650.7
650.8	650.8
650.9	650.9
651.0	651.0
651.1	651.1
651.2	651.2
651.3	651.3
651.4	651.4
651.5	651.5
651.6	651.6
651.7	651.7
651.8	651.8
651.9	651.9
652.0	652.0
652.1	652.1
652.2	652.2
652.3	652.3
652.4	652.4
652.5	652.5
652.6	652.6
652.7	652.7
652.8	652.8
652.9	652.9
653.0	653.0
653.1	653.1
653.2	653.2
653.3	653.3
653.4	653.4
653.5	653.5
653.6	653.6
653.7	653.7
653.8	653.8
653.9	653.9
654.0	654.0
654.1	654.1
654.2	654.2
654.3	654.3
654.4	654.4
654.5	654.5
654.6	654.6
654.7	654.7
654.8	654.8
654.9	654.9
655.0	655.0
655.1	655.1
655.2	655.2
655.3	655.3
655.4	655.4
655.5	655.5
655.6	655.6
655.7	655.7
655.8	655.8
655.9	655.9
656.0	656.0
656.1	656.1
656.2	656.2
656.3	656.3
656.4	656.4
656.5	656.5
656.6	656.6
656.7	656.7
656.8	656.8
656.9	656.9
657.0	657.0
657.1	657.1
657.2	657.2
657.3	657.3
657.4	657.4
657.5	657.5
657.6	657.6
657.7	657.7
657.8	657.8
657.9	657.9
658.0	658.0
658.1	658.1
658.2	658.2
658.3	658.3
658.4	658.4
658.5	658.5
658.6	658.6
658.7	658.7
658.8	658.8
658.9	658.9
659.0	659.0
659.1	659.1
659.2	659.2
659.3	659.3
659.4	659.4
659.5	659.5
659.6	659.6
659.7	659.7
659.8	659.8
659.9	659.9
660.0	660.0
660.1	660.1
660.2	660.2
660.3	660.3
660.4	660.4
660.5	660.5
660.6	660.6
660.7	660.7
660.8	660.8
660.9	660.9
661.0	661.0
661.1	661.1
661.2	661.2
661.3	661.3
661.4	661.4
661.5	661.5
661.6	661.6
661.7	661.7
661.8	661.8
661.9	661.9
662.0	662.0
662.1	662.1
662.2	662.2
662.3	662.3
662.4	662.4
662.5	662.5
662.6	662.6
662.7	662.7
662.8	662.8
662.9	662.9
663.0	663.0
663.1	663.1
663.2	663.2
663.3	663.3
663.4	663.4
663.5	663.5
663.6	663.6
663.7	663.7
663.8	663.8
663.9	663.9
664.0	664.0
664.1	664.1
664.2	664.2
664.3	664.3
664.4	664.4
664.5	664.5
664.6	664.6
664.7	664.7
664.8	664.8
664.9	664.9
665.0	665.0
665.1	665.1
665.2	665.2
665.3	665.3
665.4	665.4
665.5	665.5
665.6	665.6
665.7	665.7
665.8	665.8
665.9	665.9
666.0	666.0
666.1	666.1
666.2	666.2
666.3	666.3
666.4	666.4
666.5	666.5
666.6	666.6
666.7	666.7
666.8	666.8
666.9	666.9
667.0	667.0
667.1	667.1
667.2	667.2
667.3	667.3
667.4	667.4
667.5	667.5
667.6	667.6
667.7	667.7
667.8	667.8
667.9	667.9
668.0	668.0
668.1	668.1
668.2	668.2
668.3	668.3
668.4	668.4
668.5	668.5
668.6	668.6
668.7	668.7
668.8	668.8
668.9	668.9
669.0	669.0
669.1	669.1
669.2	669.2
669.3	669.3
669.4	669.4
669.5	669.5
669.6	669.6
669.7	669.7
669.8	669.8
669.9	669.9
670.0	670.0
670.1	670.1
670.2	670.2
670.3	670.3
670.4	670.4
670.5	670.5
670.6	670.6
670.7	670.7
670.8	670.8
670.9	670.9
671.0	671.0
671.1	671.1
671.2	671.2
671.3	671.3
671.4	671.4
671.5	671.5
671.6	671.6
671.7	671.7
671.8	671.8
671.9	671.9
672.0	672.0
672.1	672.1
672.2	672.2
672.3	672.3
672.4	672.4
672.5	672.5
672.6	672.6
672.7	672.7
672.8	672.8
672.9	672.9
673.0	673.0
673.1	673.1
673.2	673.2
673.3	673.3
673.4	673.4
673.5	673.5
673.6	673.6
673.7	673.7
673.8	673.8
673.9	673.9
674.0	674.0
674.1	674.1
674.2	674.2
674.3	674.3
674.4	674.4
674.5	674.5
674.6	674.6
674.7	674.7
674.8	674.8
674.9	674.9
675.0	675.0
675.1	675.1
675.2	675.2
675.3	675.3
675.4	675.4
675.5	675.5
675.6	675.6
675.7	675.7
675.8	675.8
675.9	675.9
676.0	676.0
676.1	676.1
676.2	676.2
676.3	676.3
676.4	676.4
676.5	676.5
676.6	676.6
676.7	676.7
676.8	676.8
676.9	676.9
677.0	677.0
677.1	677.1
677.2	677.2
677.3	677.3
677.4	677.4
677.5	677.5
677.6	677.6
677.7	677.7
677.8	677.8
677.9	677.9
678.0	678.0
678.1	678.1
678.2	678.2
678.3	678.3
678.4	678.4
678.5	678.5
678.6	678.6
678.7	678.7
678.8	678.8
678.9	678.9
679.0	679.0
679.1	679.1
679.2	679.2
679.3	679.3
679.4	679.4
679.5	679.5
679.6	679.6
679.7	679.7
679.8	679.8
679.9	679.9
680.0	680.0
680.1	680.1
680.2	680.2
680.3	680.3
680.4	680.4
680.5	680.5
680.6	680.6
680.7	680.7
680.8	680.8
680.9	680.9
681.0	681.0
681.1	681.1
681.2	681.2
681.3	681.3
681.4	681.4
681.5	681.5
681.6	681.6
681.7	681.7
681.8	681.8
681.9	681.9
682.0	682.0
682.1	682.1
682.2	682.2
682.3	682.3
682.4	682.4
682.5	682.5
682.6	682.6
682.7	682.7
682.8	682.8
682.9	682.9
683.0	683.0
683.1	683.1
683.2	683.2
683.3	683.3
683.4	683.4
683.5	683.5
683.6	683.6
683.7	683.7
683.8	683.8
683.9	683.9
684.0	684.0
684.1	684.1
684.2	684.2
684.3	684.3
684.4	684.4
684.5	684.5
684.6	684.6
684.7	684.7
684.8	684.8
684.9	684.9
685.0	685.0
685.1	685.1
685.2	685.2
685.3	685.3
685.4	685.4
685.5	685.5
685.6	685.6
685.7	685.7
685.8	685.8
685.9	685.9
686.0	686.0
686.1	686.1
686.2	686.2
686.3	686.3
686.4	686.4
686.5	686.5
686.6	686.6
686.7	686.7
686.8	686.8
686.9	686.9
687.0	687.0
687.1	687.1
687.2	687.2
687.3	687.3
687.4	687.4
687.5	687.5
687.6	687.6
687.7	687.7
687.8	687.8
687.9	687.9
688.0	688.0
688.1	688.1
688.2	688.2
688.3	688.3
688.4	688.4
688.5	688.5
688.6	688.6
688.7	688.7
688.8	688.8
688.9	688.9
689.0	

PEAK OUTFLOW IS 8260. AT TIME 4:25 HOURS

	PEAK	4-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8260.	3583.	2277.	2277.	275187.
CPS	254.	101.	64.	64.	7756.
INCHES		15.66	17.65	17.65	17.65
MM		423.29	448.25	448.25	448.25
AC-FT		1777.	1881.	1881.	1881.
CU-FT		2151.	2221.	2221.	2321.
THOUS CU-FT					2.321.

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

OPERATION	STATION	AREA	RATIOS APPLIED TO FLOWS				
			RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
			20	40	50	50	1.00

HYPOCYPAIN AT	A1	2.00 5.18	1	202. 58.95	414. 117.50	525. 147.30	227. 63.70	1040. 257.75
SMUTIN TC	A2	2.00 5.18	1	75. 21.48	261. 74.33	357. 101.95	237. 184.51	266. 235.90

## SUMMARY OF RAM SAFETY ANALYSIS

FLAN 1 .....	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 637.50 1966. 0.	SPILLWAY CREST 637.50 1966. 0.	TOP OF DAM 639.40 1970. 613.	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TYPE OF MAX OUTFLOW FAILURE	TIME OF FAILURE HOURS
RATIO OF PPE	MAXIMUM RESERVOIR WATER LEVEL	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT					
.20	629.54	.14	1203.		759.	1.92		0.00
.30	630.47	1.07	1915.		2618.	3.75		0.00
.50	640.79	1.59	1435.		3597.	4.50		0.00
.70	641.56	2.16	1540.		6387.	5.50		0.00
1.00	641.69	2.89	1992.		8280.	6.00		0.00

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC



APPENDIX 4

REFERENCES

BOONTON RESERVOIR DAM



## APPENDIX 4

### REFERENCES

#### BOONTON RESERVOIR DAM

1. King, H.W., and E.F. Brater, Handbook of Hydraulics, McGraw-Hill Book Co., New York, Fifth Edition, 1963.
2. New Jersey Department of Environmental Protection Files, "Dams in New Jersey - Reference Data" Dam Number 22-25.
3. U.S. Department of Commerce, Weather Bureau, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24, and 48 Hours," Hydrometeorological Report No. 33, Washington, April 1956.
4. United States Department of the Interior, Bureau of Reclamation, Design of Small Dams, U.S. Government Printing Office, Washington, 1977, 815 pp.
5. United States Department of the Interior, Geological Survey, 7.5 Minute Series (Topographic) Maps, Scale 1:24,000, Contour Interval 20 Feet: Boonton, N.H., (1954).
6. United States Department of the Interior, Geological Survey, 7.5 Minute Series (Topographic) Maps, Scale 1:24,000, Contour Interval 20 Feet: Pompton Plains, N.J., (1955, Photorevised 1970).